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Old Dominion Steamer Tyler

The Latest Addition to the Atlantic Coast Fleet for Exclusive Freight Service

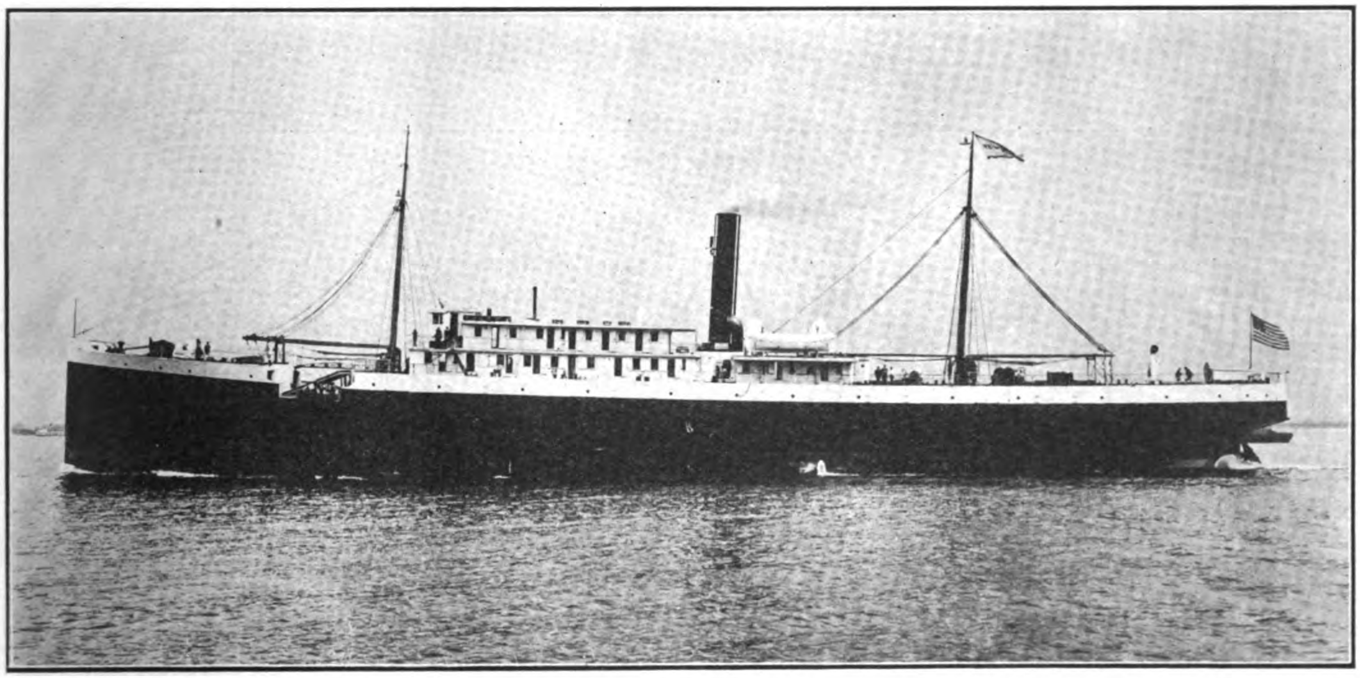
THE New York Ship Building Co., Camden, N. J., recently delivered the steamer Tyler to the Old Dominion Steamship Co., of New York, intended exclusively for freight service. Her dimensions are as follows:

Length over all	344 ft.
Length on water line	331 ft.
Beam, extreme	47 ft.
Depth, molded, to hurricane deck	35 ft.

The steamer is classed A-1 in the American Bureau of shipping. The appearance of the vessel is well indicated in the accompanying photograph. The bow is of a bluff type and was adopted after a series of model tests demonstrated that it would best meet the requirements for speed and power.

The hull is divided into six watertight compartments. The propelling machinery is located amidships. There is one three-cylinder, triple-expansion engine, supplied by two single-end Scotch marine boilers, the boiler and engine rooms being separated by a screen bulkhead. All the auxiliary machinery in the way of pumps, heaters, filters, etc., is of a very complete and up-to-date character. Coal is in bunkers abreast the boiler room, port and starboard.

The Tyler has four decks, namely, orlop, lower, main and hurricane, with deck houses amidships, two steel masts and one funnel. Fourteen cargo ports are fitted, six between the lower and main decks, port and starboard, and eight between the main and hurricane decks, starboard. Gangway doors are fitted abreast the large cargo hatches in way of the well forward. Large cargo hatches are fitted to the forward and after holds with two freight elevators between the hold and main deck and one between the hold and hurricane deck. Freight is handled by two 10-ton steel booms on the foremast and one 3-ton and two 5-ton wooden booms on the main mast. For working the cargo, four powerful steam winches are fitted, two at the foremast and two at the main mast; smaller winches are fitted at each elevator hatch to handle lighter cargo. The remaining deck machinery consists of a Hyde windlass and capstan forward and two capstans aft. Steering is by a quadrant on the hurricane deck, with leads running forward to a steering engine amidships.



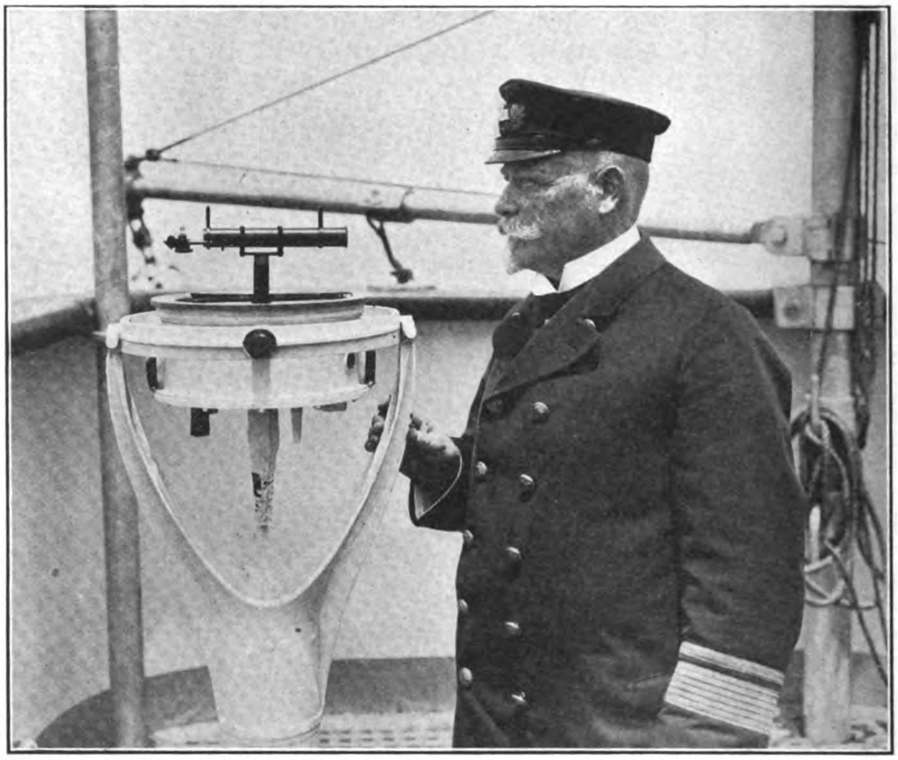
THE OLD DOMINION STEAMSHIP CO.'S STEAMER TYLER ON TRIAL
Built by the New York Shipbuilding Co., Camden, N. J.

Accommodations are provided for the crew in the deckhouse amidships. Fresh water is carried in built-in tanks aft. The trim is maintained by tanks in forward and after peaks. The speed at sea is to be 12 knots.

The Giant Imperator

Her Unprecedented Proportions Makes Her Public Cabins and Staterooms Unusually Elaborate

IN the July MARINE REVIEW attention was given the structural, engineering and life-saving features of the new Hamburg-American liner Imperator. The present article deals with the human side, the living quarters, with which no other ship compares.



VICE ADMIRAL HANS RUSER, COMMANDER OF THE IMPERATOR

Taking advantage of her unprecedented proportions, her public cabins and staterooms have been made unusually large and luxurious. Despite her great size, however, the Imperator will carry only a few more passengers than steamers of one-half her tonnage, in order to assure the maximum of comfort for all. The Imperator has 83 life-boats, including two motor boats. Special cranes permit the launching of many of the boats from either side.

The upper, or sun deck of the Imperator (A Deck), which is nine decks above the water-line, is largely devoted to the recreation of the passengers. The unusual length and breadth of this deck renders it especially attractive for promenading as well as for steamer chairs. Many of the life-boats are carried on this deck, but in fair weather, these are swung outboard to gain additional space. The only staterooms on this deck are the officers' quarters, immediately adjoining the bridge. The Imperator is commanded by a Commodore and four Captains, one of whom will be on duty at all times. The smoking room, which is located on this deck, is one of the largest cabins set aside for the purpose on any ship. It extends nearly the width of the ship, assuring ample light and ventilation.

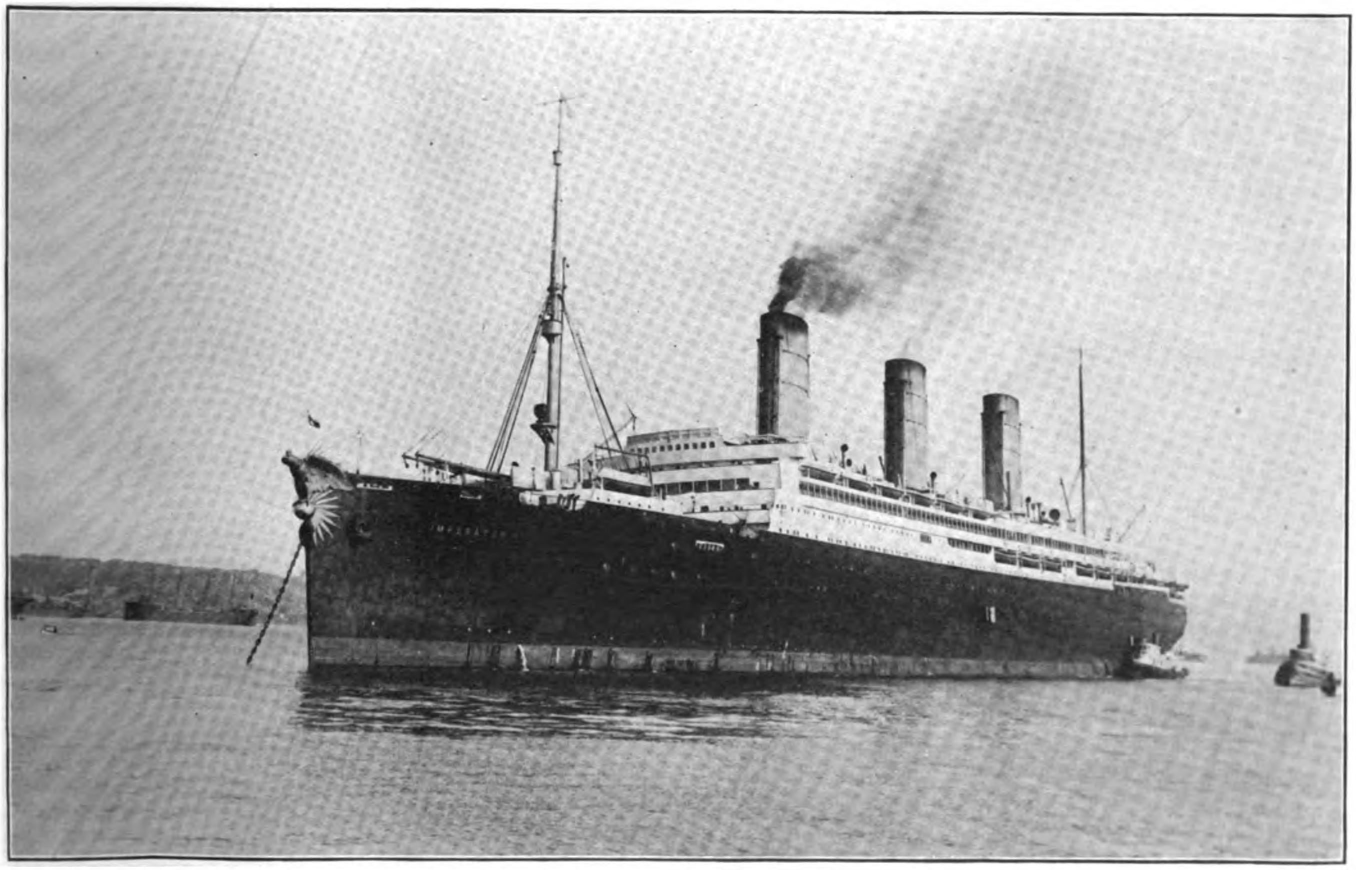
Opening from the promenade is a large gymnasium equipped with the electrically-driven Zander apparatus, directed by experienced attendant. A large and completely equipped photographic dark room, situated on this deck, is placed at the disposal of the passengers. Nearby is the Telefunken Wireless Telegraph station attended by three operators, one of whom is always on duty at the key. This wireless station is sufficiently powerful to enable the ship to keep within direct communication with land throughout the Atlantic crossing. The ship's printing office, where the daily newspaper is published, will also be found on this deck. A novel feature of this deck is the dog kennels in charge of special attendants.

The upper deck is conveniently reached by broad staircases as well as by four electric passenger elevators, each carrying nine persons. There are five other elevators for carrying provision, baggage and the mails, all of which are operated by electricity. It will be noticed that this deck has none of the large ventilating funnels to be found on many other ocean steamers, thus affording additional deck space for the use of passengers. Perfect ventilation throughout the ship is assured by a system of forced draught which carries abundant fresh air to every deck.

The next deck (B Deck) is occupied almost entirely by the public rooms, which are large and luxuriously appointed. The deck is completely surrounded by a broad promenade similar to that of the sun deck. The largest of these rooms is the Social Hall, situated well forward and extending nearly the width of the ship. The hall is lighted by broad windows extending to the floor and is sumptuously furnished, the walls being hung with Goblin tapestries. The hall may be converted into a ballroom or a theatre. A theatrical stage is placed at one end of the hall. A spacious room of almost equal size is set aside at a ladies' salon and writing room.

Another attractive feature of this deck is the Palm Court and Sun Parlor. Adjoining this cabin is the Ritz-Carlton Restaurant where a distinctive cuisine may be enjoyed. Still another feature of this deck is the Grill Room and Veranda Cafe. All of these cabins are designed with broad, low windows and compare favorably in size and decorations with the dining rooms of the most palatial hotels. A private dining room, seating ten persons, is also situated on this deck available for private dinner parties. There are in all eight completely equipped kitchens. The kitchen personnel comprises two chief chefs assisted by 116 cooks and kitchen assistants, including five pastry cooks,

BRIDGE OF THE HAMBURG-AMERICAN LINER IMPERATOR



HAMBURG-AMERICAN LINER IMPERATOR

a sauce chef, five butchers, twenty-one silver cleaners and glass washers and many others. More than 500 persons are employed in the serving personnel of the Imperator. The office of the public stenographer is also situated on this deck. The forward part of this deck is enclosed with glass, converting it into a spacious sun parlor during the winter months. A candy shop and a florist are situated near the doors of the electric elevators.

A third promenade will be found on the deck below (C Deck). This deck is devoted to the staterooms and the larger private suites. The largest of these, the Imperial Suite, comprises twelve rooms and a private veranda deck, assuring the privacy of a luxurious home. The private deck, the first to be installed on shipboard, is enclosed and serves as a sun parlor in the winter season. The suite includes two large bedrooms with private baths, trunk rooms, a breakfast room with pantry, a salon and two servants' rooms. The staterooms of the Imperator are unusually large throughout, doing away with any suggestion of crowding.

The Service Staff

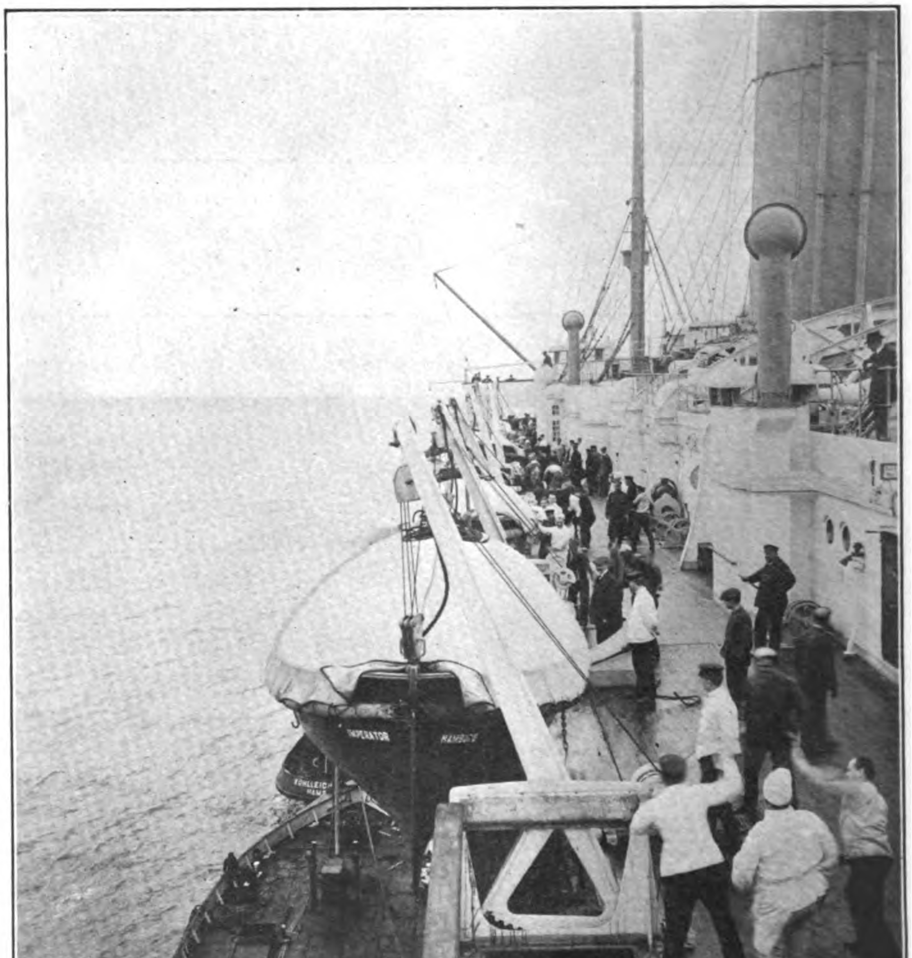
The next deck (D Deck) is also occupied exclusively by staterooms. All of these decks are unusually well supplied with bathrooms. In the first cabin alone there are no less than 229 regular baths and showers, including 146 private bathrooms. A large proportion of these cabins are single berth rooms, The conventional ships' berths familiar to sea travelers have been replaced by brass bedsteads of artistic designs. Each stateroom is equipped with a marble washstand with running hot and cold water. Special attention has been paid to the designing of dressing tables, mirrors and the placing of lights. In the first cabin alone there are 714 fixed beds, 194 sofa beds and reserve beds and fourteen children's beds. In this connection it is interesting to note that the linen supply on an outward voyage includes 7,500 bath towels, 159 bath robes, 9,700 bed sheets and spreads, 30,000 towels, 12,250 pillow, cushion and bolster slips, 43,300 napkins. The linen used on a voyage is valued at $50,000.

The excellent service for which the Hamburg-American Line is famous is assured by a large, well organized staff of stewards. In the first cabin alone there is a chief steward with a staff of ten assistants directing a staff of 271 stewards including 14 stewardesses, and a housekeeper.

A system of intercommunicating telephones connects every stateroom with other parts of the ship. On this deck, convenient to the electric elevators, will be found the office of the Passenger Department and the Baggage Office. Forward on this deck are five great anchors, a main bow anchor weighing 26,455 pounds, two additional anchors weighing 17,636 pounds, a fourth of 11,463 and a warp anchor of 4,960 pounds. These anchors are secured by enormous steel chains having a total length of 1,280 yards or three-quarters of a mile. The anchors and chains have a combined weight of 485,012 pounds.

The conspicuous feature of the next deck (E Deck) is the upper portion or gallery of the main dining room. This room occupies two decks and seats all of the first cabin passengers at one time. It is sumptuously decorated. On this deck will be found two additional private dining rooms, as well as the purser's office, telephone exchange and chief steward's office.

On the deck below (F Deck) is the main floor of the dining room, which extends the width of the ship. The dining saloon accommodates over 600 persons. Tables are provided for two, four, five or six persons. The saloon is lighted by windows of unusual size, and an elaborate glass dome raised high above the gallery. The doctor's office, with waiting room, and the hair dresser and barber shop, are also placed on this deck. The three electric elevators run to this deck, thus passing through six decks. One of the most unique features of the Imperator, the Roman Bath, is situated in this deck, F, and Deck G beneath. The bath and swimming pool, which is therefore two stories in height, is carried out in marble and bronze. The bath measures 65 feet in length and 41 feet in width, while the pool itself is 39 feet long, 21 feet wide, with a maximum depth of 9



BOAT DRILL ON BOARD THE HAMBURG-AMERICAN LINER IMPERATOR

feet. Directly connected with the Roman Bath is a completely appointed Turkish bath, an electric bath, mineral bath, foot bath and needle bath, and a chiropodist, barber and manicure.

Canadian Canaler Glenmavis

Description of an Irish-Built Freighter for Lake Trade—First to be Built on the Ballard System

THE Glenmavis is the first vessel to be completed by the newly constituted North of Ireland Shipbuilding Co., at their Londonderry yard, and belongs to what is known as the Canadian Canal type of lake freighter, in which the dimensions and draught are limited by the size of the canal locks through which such vessels trade. She is building for the Playfair interests.

As will be seen from Fig. 1, the Glenmavis follows in general arrangement and outfit the standard practice evolved by experience for a vessel of her class. She differs, however, from other lake vessels in that she is the first of this type to be constructed on the arch principle devised by Mr. Maxwell Ballard, by which a considerable saving in weight of structural material is effected in comparison with the usual system of construction.

The leading particulars of the Glenmavis are:

Length overall	256 ft.
Length B. P.	250 ft.
Breadth extreme	42 ft. 6 in.
Depth molded to knuckle	16 ft.
Depth of arch	4 ft.
Total depth	20 ft.
Load draught	14 ft.

The vessel has been classed with the British Corporation for service on the Great Lakes and the St. Lawrence river. Her structural design and scantlings are shown by the profile given in Fig. 2 and the sections at an ordinary frame and a web frame given in Figs. 3 and 4, respectively. It will be seen that the vessel has no sheer, the necessary height forward being secured by the adoption of a forecastle, while a bulwark is fitted round the stern aft. Following lake practice, the vessel has no 'tween decks, compensating strength being secured on the girder system, leaving the cargo hold free of all obstructions. A cellular double bottom for water ballast, with floors on alternate frames, extends all fore and aft, and there is also a large peak ballast tank forward. The frames are of bulb-angle section spaced 24 in. apart, except right forward where the spacing is reduced to 21 in. and 18 in., as shown on the profile (Fig. 2). The tank top is flush plated, in order not to interfere with the working of grabs, and has no ceiling. Fenders are fitted on each side for protection when passing through the locks.

There are five cargo hatchways, 12 ft. by 28 ft. 6 in., with shallow bulb-angle coamings, and one large hatchway aft, 26 ft. by 28 ft. 6 in., by about 4 ft. 6 in. high. The latter provides extra capacity, and at the same time assists the trim of the vessel. The hatchways are spaced 24 ft. centers. Canadian canal steamers, as a rule, have no cargo gear on board and none is shown in Fig. 1, but it is understood that the owners contemplate adding four winches with the corresponding cargo gear, masts, and derricks when the vessel reaches the lakes.

On account of the confined waters which the vessel navigates, a balanced rudder of large area is provided. The

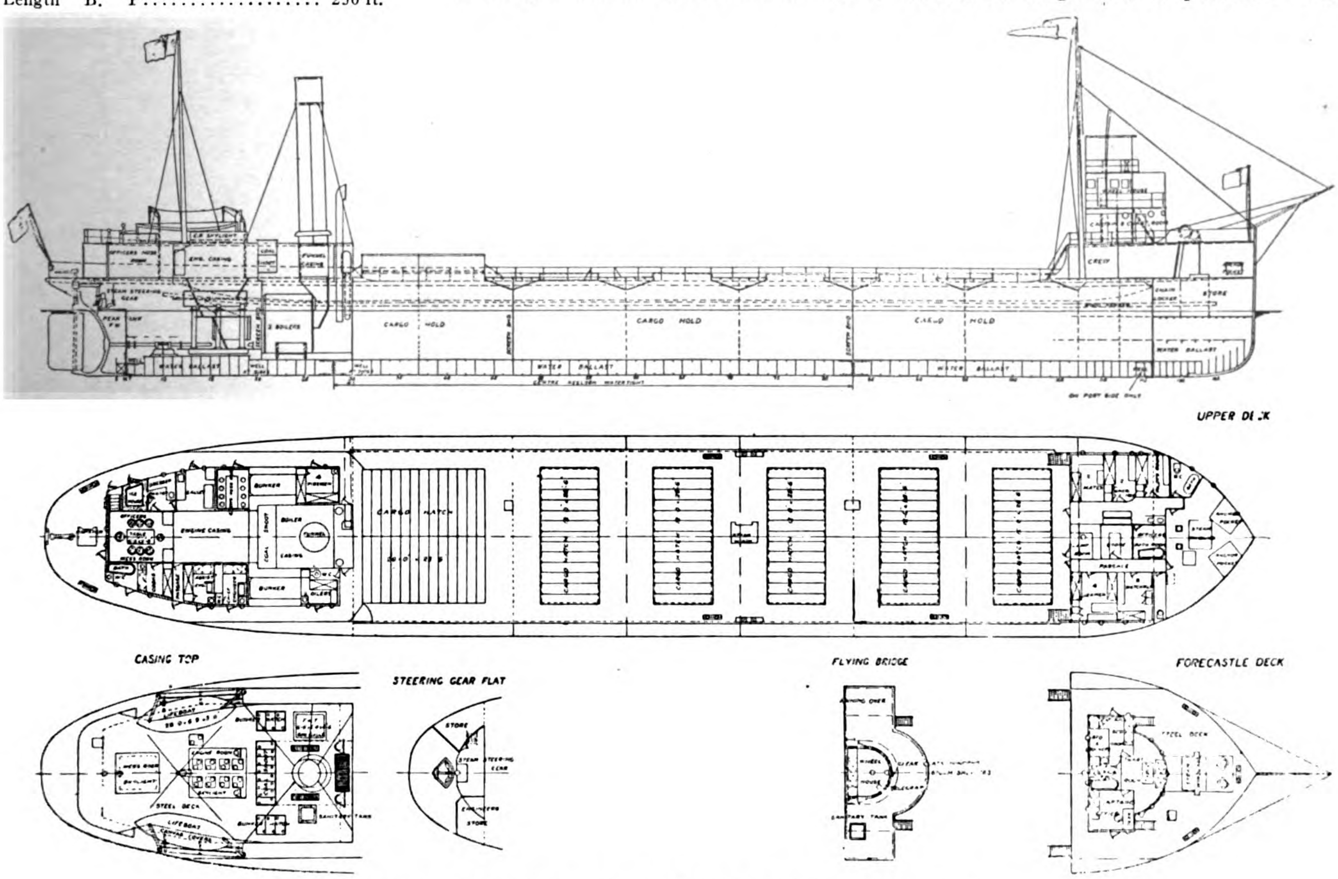


FIG. 1.—GENERAL ARRANGEMENT OF THE GLENMAVIS

rudder is worked by a steam steering gear of special design, situated beneath the arch deck aft and controlled either from the navigating bridge forward or from a steering station on top of the after deck house. A reserve tiller is also provided on top of the arch deck, the rudder head being carried up through the deck for this purpose. To facilitate steering from the forward bridge, a steering pole is fitted at the stem to give the steersman a point to steer by. A powerful steam windlass is fitted under the forecastle deck, and arranged as shown on the plan, while for warping purposes a steam winch is provided amidships and a steam capstan aft. The anchors are housed in pockets to avoid fouling the lock gates.

The accommodation follows the arrangement usually adopted in lake vessels. As will be seen from Fig. 1, the officers and seamen are berthed in the forecastle, above which is a steel house containing the chart room and the captain's office and bedroom. Above the captain's house is the flying bridge, upon which is placed the wheel house. The engineers and firemen are accommodated in steel houses at the sides of the engine and boiler casing on the arch deck aft. In the after house are also arranged the galley and pantry, the officers' mess room, an ice house, and the mess room for the crew.

The vessel is propelled by a single screw, driven by a set of triple-expansion reciprocating engines, having cylinders 16, 26 and 44 in., respectively, with a stroke of 30 in. Steam is supplied by two single-ended cylindrical boilers, 12 ft. 6 in. diameter by 10 ft. 6 in. long, designed for 180 lbs. pressure and working under natural draft. The propelling machinery was constructed by Richardson, Westgarth & Co., Middlesbrough, but was installed at the Londonderry yard.

The particulars of this article have been abstracted from the *Shipbuilder* Newcastle-on-Tyne, and it is understood that a duplicate is building.

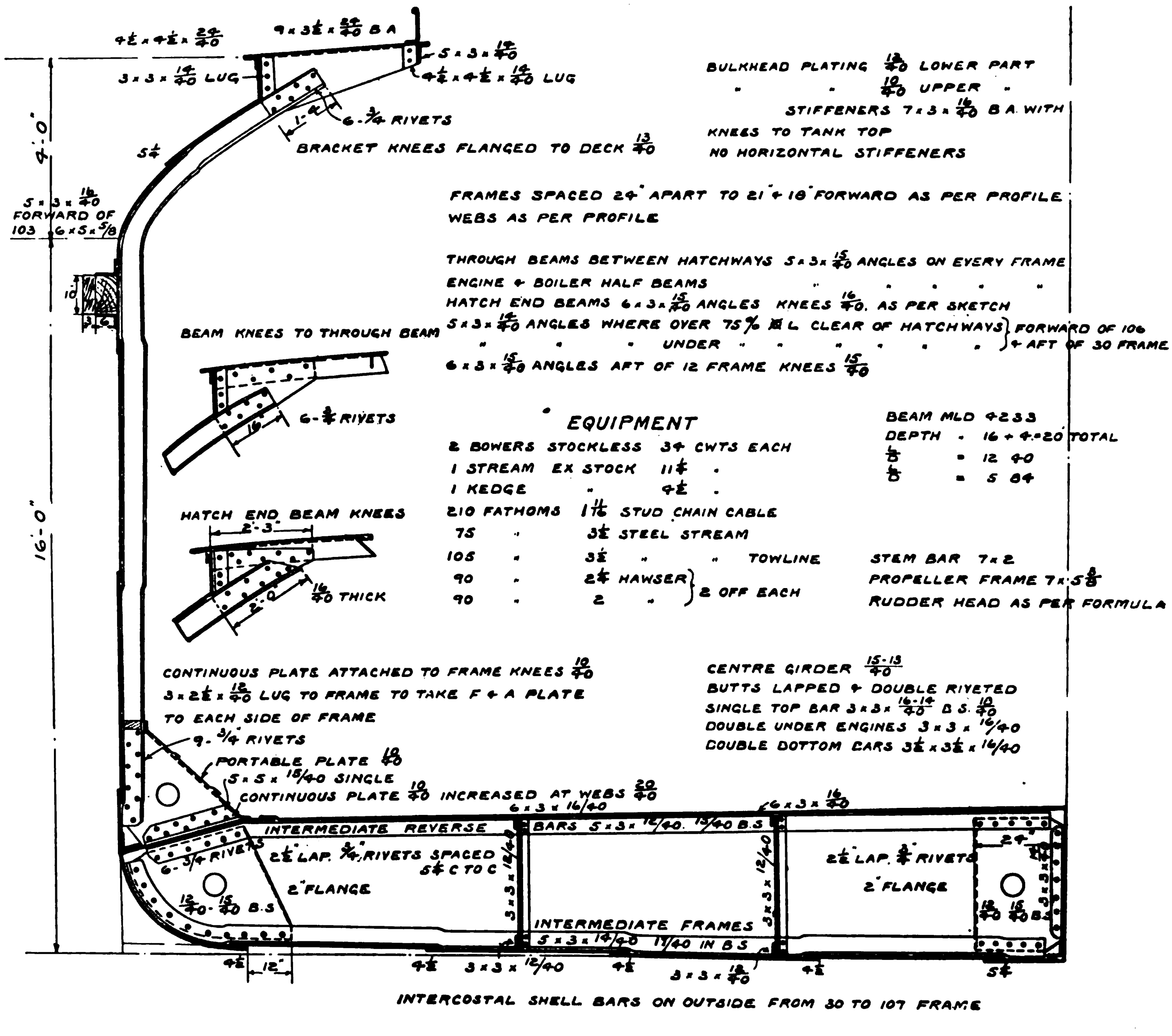


FIG. 3.—SECTION OF THE GLENMAVIS AT AN ORDINARY FRAME

Feat of Old Sailing Days

In its issue of Mal 29 the *Republican Journal,* of Belfast, Maine, published a very interesting article signed by W. S. Devereaux, with extracts from the log of the New York Sandy Hook pilot boat William J. Romer, which made a voyage to Cork, Ireland, and return, leaving New York February 6, 1846. The announcement was made in the daily papers that this event would take place as above, thereby creating no little excitement among shipping men. It was surmised, although never made public, that this voyage had something to do with carrying important dispatches to Great Britain, as the British consul was a member of the firm who chartered this vessel. There were two passengers on board, the first a spe-

cial agent of the State Department at Washington, also an attache of the British legation. The Romer's crew consisted of Capt. James McGuire, navigator; John R. Wilkes, mate, and James Connor, second mate, both Sandy Hook pilots; Marshall Green, cook and steward; George Colton, James McLeslie and Edward Fryes, seamen; James B. Johnson, boat-keeper.

The Romer according to Capt. Johnson was only about 70 ft. long over all and far from being a safe craft to make that voyage in the winter time. The following extracts from the log are certainly interesting reading:

February 6. As we passed out, Sandy Hook the big packet ship Patrick Henry was just astern of us and we hoped we might beat her on the run across. The wind was strong N.N.W.

12th. Experienced our first setback in a strong easterly gale. Hove-to under a reefed main storm-trysail. Shipped a sea which carried the binnacle overboard. Blowing a hurricane and our chances on keeping afloat slim. Gale abated, wind shifted to west, made sail the third day.

18th. Shipped a heavy sea which tore away part of cockpit. Running before it with great danger of being "pooped" or broaching to. Here is where the Patrick Henry is getting the better of us.

20th. Lay-to with a drag out, blowing a hurricane and a tremendous sea running.

22nd. Just before noon lashed the captain to the mainmast, where he succeeded in getting the sun for the first time in several days. Lat 43.28 passed a bark under close reefs heading west.

24th. While laying-to about 7:30 P. M. a squall from the N.W. struck us and buried the little craft to the hatches. For a few minutes she hesitated to right or remain over. When she did right one big green sea enveloped her but she shook it off. A little later it moderated, and in wearing ship a heavy sea "pooped" her, nearly washing the man at the wheel overboard. Then she broached to and we thought that was the end of the Romer, but it wasn't to be. During this gale we lost our drag with sixty fathoms of hawser, the square-sail boom and yards and two pigs of iron attached.

27th. On the afternoon of this day the gale of three days subsided and with a fair wind cracking on we soon forgot past dangers, while the little craft skimmed the dark waters like a stormy petrel on our course to the eastward.

March 1. We passed and spoke the packet ship St. Patrick from Liverpool

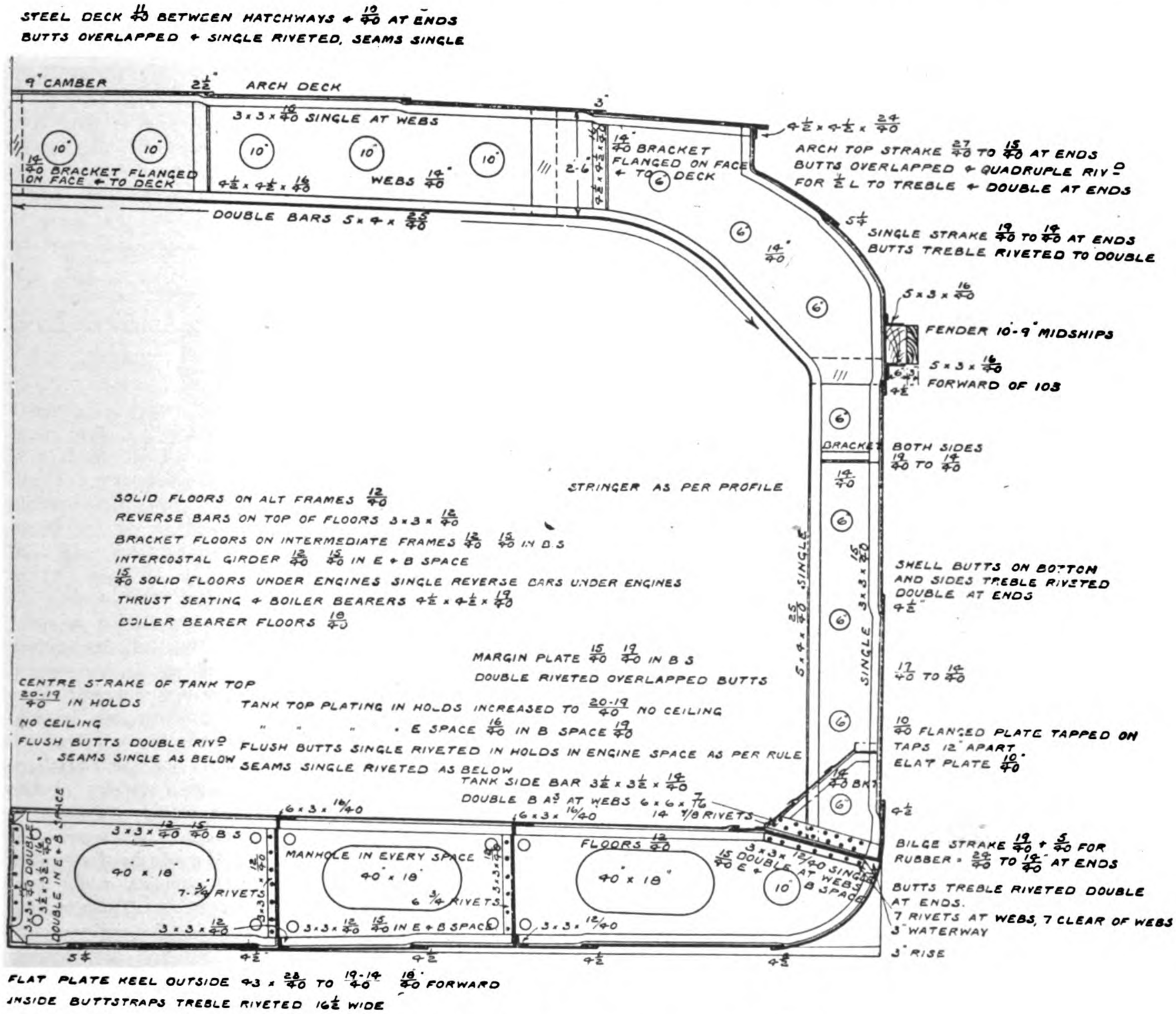


FIG. 4.—SECTION OF THE GLENMAVIS AT A WEB FRAME

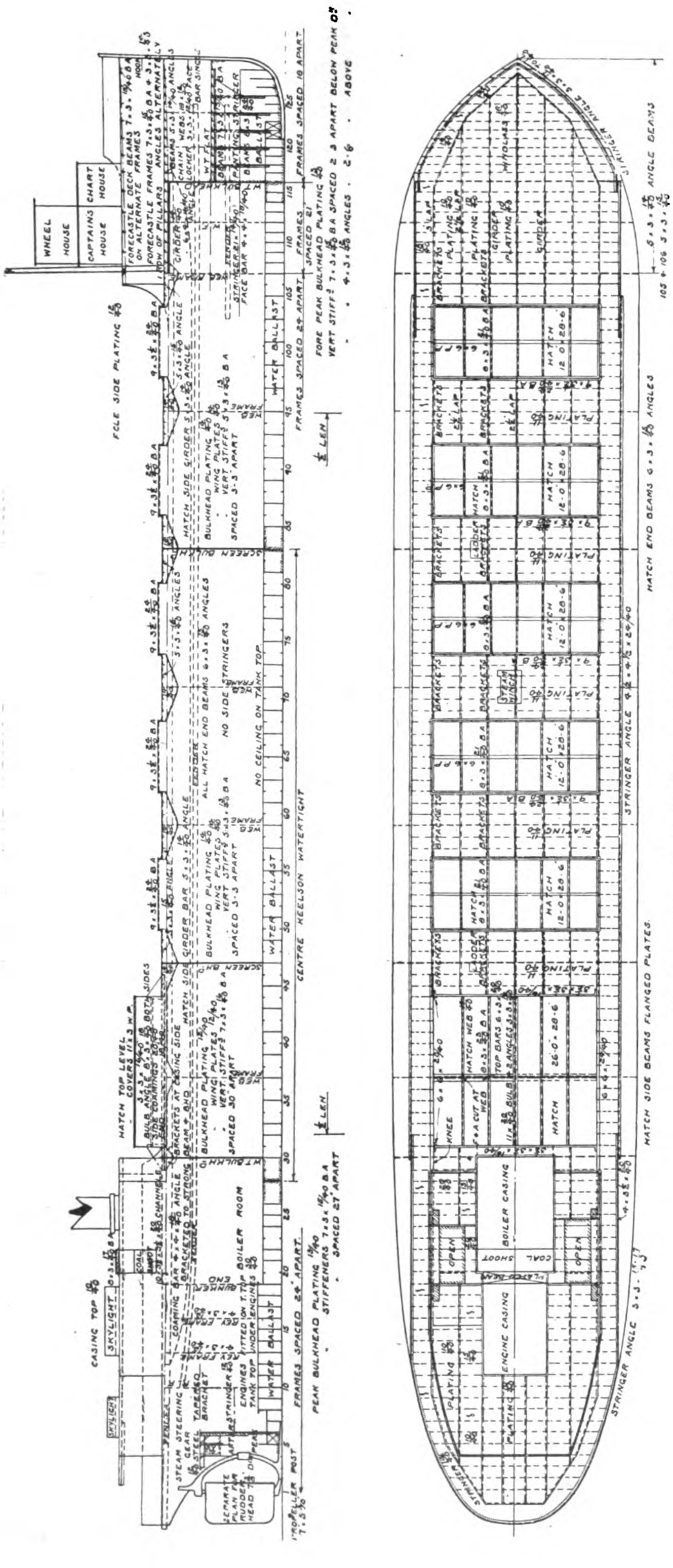


FIG. 2.—PROFILE AND DECK PLAN OF THE GLENMAVIS

for New York, the second vessel seen on the passage.

4th. For the first time during the voyage a dry spot was visible on the deck.

6th. At 4:30 P. M. made the Skelly Rocks bearing N.N.E. dist. 18 miles and at 11 P. M. made Cape Clear light 16 miles distant.

7th. At 9 P. M. pilot boarded us and took the Romer into the harbor of Cork three days after the Patrick Henry arrived at Queenstown, after a voyage across the Atlantic that could not have been more tempestuous, but the Romer survived it.

Arriving at Cork our secret messenger left immediately for Liverpool, returning March 12, and at noon the 13th, the Romer was on her return trip for New York, where she arrived after twenty-eight uneventful days in comparison to the outward voyage, owing to taking the southern route.

Another Hamburg-American Liner With Diesel Engines

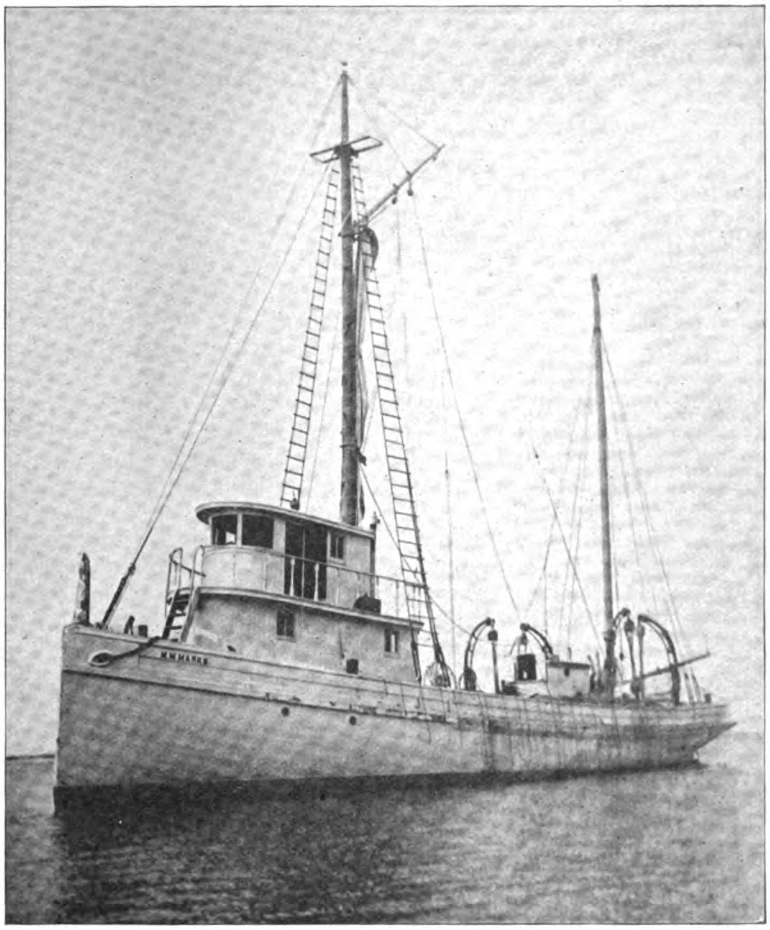
From the shipyard of Blohm & Voss, Hamburg, has been launched the motor cargo vessel Kurmark for the Hamburg-American Line. This vessel is of 7,500 tons gross displacement and will be provided with two single-acting, four-cylinder, two-stroke cycle, Diesel engines developing a total of 2,700 b. h. p.

Two four-cylinder, four-stroke-cycle auxiliary engines, each driving a dynamo, are provided; one of the engines also drives an injection air compressor, and the other a maneuvering air compressor. The compressors can be disconnected. A small two-cylinder set, driving a dynamo and an auxiliary compressor, serves as a standby. When at sea the main engines themselves effect the operations necessary for their working. One of the four-cylinder auxiliary sets supplies, when running at a moderate speed (about 250 r.p.m.), the electricity for lighting the interior of the ship and for driving the steering gear, ballast pumps, lathe and reserve auxiliary pump. The other auxiliary engine forms a reserve. Cooling-water pumps, bilge pumps, etc., are driven from the main engines. The small reserve set generates the current for lighting when in port.

W. L. Thompson, formerly in charge of the sluicing operations back of Gold Hill, Culebra, canal zone, has resigned to accept the position of chief engineer of the Mississippi state levee board with headquarters at Greenville, Miss.

Producer Gas Fishing Boat

The M. M. Marks is Said to Run at a Fuel Cost Equivalent to Two Cents for Gasoline



THE FISHING VESSEL H. N. MARKS EQUIPPED WITH 75-H. P. GALUSHA MARIN GAS PRODUCER.

THE accompanying photograph is of the fishing steamer M. M. Marks, which among other things is very interesting because of the remarkably low cost of her fuel and power. The boat is strongly built, and is 87 3/10 ft. long, 18½ ft. beam and 7½ ft. deep. Net tonnage is 62; gross tonnage 82; and draught about 6 ft. 2 in.

The 75 H. P. engine is a three-cylinder "Wolverine" 11 in. bore and 12 in. stroke, turning 320 revolutions per minute. The fuel used is anthracite pea sized coal, costing the owners about $4.00 per ton when bought in the north, or $6.00 per ton if bought at Beaufort, N. C. The coal is made into gas by a suction marine gas producer.

The owners write as follows in regard to the operations: "The motor works excellently on producer gas, with the utmost regularity and minimum attention. In a 12-hour run we used 875 lbs. of coal, making 8½ miles per hour. In a run from Pocomoke City, Md., to Beaufort, N. C., a distance of over 300 miles, the engine ran uniformly and most satisfactorily. The gas producer is giving satisfaction and we are contemplating installing them in our other boats.

"Added to the other advantages of this producer, it may be manipulated from dead slow to full speed and runs at a cost equivalent to gasoline at 2 cents per gallon."

The 330 mile trip above referred to was made part of the way in very stormy weather with one or the other rails of the boat under water at times. The engineer on this boat writes as follows: "Just came from a fishing trip with about 125,000 lbs. of fish. Producer worked fine all of the way. Burned a fraction over one ton of coal from Friday evening 8 P. M. to Wednesday morning 5:10. This, not including Sunday. I was also able to run with the 125,000 lbs. of fish and use the main exhaust through the stern, which I found was only under the water about 4 in. The Marks can run the Pilgrim out of sight in a 10 hour run, provided the Pilgrim cannot use her sails. It has been tried."

The noted racing boat Pilgrim has about the same horsepower as the Marks, but uses gasoline instead of producer gas. The owners of the Marks, after carefully observing her operation, have now ordered a duplicate gas producer for a sister boat.

The fishing schooner Sussex built by Capt. R. T. Potter last year, is also giving excellent results. Her 75-H. P. 3 cylinder, 11 by 12 engine, was originally built for gasoline and kerosene fuel. After being put into the boat the rise in the cost of oil resulted in the addition of a 75-H. P. marine gas producer built by A. L. Galusha & Co., of Boston, Mass.

The engine now runs on producer gas and turns about 334 revolutions per minute. Instead of using $18.00 worth of kerosene or $36.00 worth of gasoline in the 19 hour trip from Lewes, Del., to New York City, the fuel consumption is now but 1,152 lbs. of coal, costing less than $3.00, or compared with kerosene, and $33.00 compared with gasoline in each 19-hour run.

On May 4, 1913, the engineer wrote as follows of this boat's power plant: "We were 19 hours from Lewes to New York and burned 24 hoppers of coal (48 lbs. each) running at 300 revolutions per minute with the throttle a little over 2/3 open and when wide would turn 334 revolutions per minute. The moisture proved to be sufficient to keep the fire down to a normal without changing the mixture at any time. The producer ran with absolutely clean walls and no clinkers in the ashes larger than an apple, and was able to keep the fire about two feet deep by giving all the moisture. Had no trouble at all with either producer or engine."

The latest word received from Capt. Potter in regard to the power plant

on the Sussex was from Philadelphia and was as follows: "I will say that I came up last night to bring or steer the Sussex up from Lewes and the producer and the engine seem to run very nice and steady, and at good fair speed."

One point that apparently interests boat owners very much is the thorough reliability that these plants are showing in addition to the great saving in fuel and labor cost, as compared with any and all other kinds of marine power. The plants have certainly much to commend them.

Suction Between Passing Vessels

The Affair of the Olympic Has Aroused British Navigators to the Importance of This Subject

By Prof. A. H. Gibson, D. Sc., and J. Hannay Thompson, M. Sc.

THE experiments to be described in this paper have been carried out with a view of obtaining some information as to the magnitude and range of action of the forces involved in the case of "suction" or interaction between passing vessels. Up to the present time in such experiments as have been performed models of comparatively small size have been used, and while these have given extremely valuable results, some doubt has been expressed as to the extent to which their results are susceptible of extension to the case of vessels of large size.

In the present series of experiments two screw propelled vessels were used. One of these, the steam yacht Princess Louise, is 88.5 ft. in length, 13 ft. beam, 5.66 ft. mean draught, displacing approximately 96 tons. The second is a motor-driven launch, 29.33 ft. long, 6.75 ft. beam, 1.37 ft. mean draught, displacing approximately 2.6 tons. Each is driven by a single screw. The experiments were divided into two distinct sets. In the first the vessels were maneuvred until on sensibly parallel courses, heading for the same distant object, their lateral distances apart and speed being varied in different experiments. The courses having been satisfactorily fixed, with the helm of the motor boat amidships, this helm was lashed, the helm of the Princess Louise being afterwards manipulated so as to keep her on her original course. Two plane tables with alidades were mounted on the deck of the Princess Louise, distant 67 ft. 8 in., center to center, and the relative position of the motor boat was fixed at intervals of fifteen seconds during each run by means of simultaneous sights taken from these. Both vessels were calibrated on the measured mile before the experiments, and speed revolution curves were obtained from which, by counting the revolutions, the speed of each vessel could be ascertained or regulated. These data enabled the relative positions and paths of the two vessels to be plotted with a close degree of accuracy, and the diagrams illustrating the paper have been obtained in this way. With a view of measuring the forces and moments involved a series of eight pressure-boxes were fixed to the hull of the motor boat at about 12 in. below the water-line. These are circular, have a diameter of 1½ in., and a maximum thickness of ⅜ in., and communicate with the sea through four 1/16 in. holes in a 1in. circle. They are in pairs at similar positions on the port and starboard sides, and distant 4 ft., 10 ft., 16 ft., and 22 ft. from the bows. Each corresponding pair was attached by means of rubber tube connections to the branches of one of a series of inverted U tubes carried on deck, and by exhaustions of the air from the top of the tubes a column of fluid from each pressure-box was brought on to a graduated scale, from which the differences of pressures at corresponding points were determined. Each pair was calibrated at different speeds so as to give the zero reading with the boat travelling on a straight course and remote from any disturbing influence.

Readings of the gages were taken each fifteen seconds in a number of the experiments, and from these the turning moments and lateral forces acting on the hull of the boat have been computed. The second series of experiments was carried out with a view of measuring the helm angle required to maintain the course of the smaller, when in the vicinity of the larger vessels. In these experiments the relative positions of the two boats were obtained as before, the helm being adjusted as required to keep the head of the vessel on its original course. The helm angle was measured by means of a pointer fixed to the tiller, and working over a graduated sector, and was observed at intervals of 15 seconds. The rudder originally fitted to the motor boat was proportionately about three times as large as is fitted to the average sea-going steamship. This was replaced for the purpose of the experiments by a rudder of 144 square inches area, for which one of 75 square inches area was afterwards substituted, the latter representing approximately to scale the rudder fitted to the average large steamship. The results of control experiments using each rudder in turn are given at a later stage of the paper. Owing to the risks involved in the collisions the speed of the vessels was restricted to a maximum of about 5.75 knots, which, in the case of the Princess Louise, corresponds to 18 knots in a vessel of the dimensions of the Olympic (882 ft. long). The minimum speed was about 3.5 knots. Owing to the local conditions it was found impracticable to carry out the experiments in shallow water of even approximately constant depth, and, except in two experiments (Nos. 41 and 42, Fig. 5), where the water was about 12 ft. deep, the depth actually ranged from 20 ft. to 30 ft. Since this is from twelve to twenty times the mean draught of the smaller vessel, these are essentially deep-water experiments, and, as is indicated both by theory and experiments, the forces involved are in general less than would be experienced in shallow water.

2.—General Theory of Interaction.

When a ship-shaped body is towed through still water both theory and experiment show that a general circulatory motion is set up in the surrounding fluid. Those particles ahead of the bows are first affected, being forced forwards and outwards into a fan-shaped region extending ahead from the bows, in which the pressure and elevation are greater than normal. From this region a general flow takes place, backwards and in-

*Institution of Naval Architects.

wards to fill the space vacated by the stern. As the velocities of flow increase the pressure diminishes, to become a minimum abeam of the body, while as, due to convergence at the stern, the velocities diminish, the pressure again increases. The body, thus carries along with it a region of depression abeam and fan-shaped regions of excess pressure and super-elevation respectively ahead of its bows and in the rear of its stern. The pressures and velocities of flow diminish rapidly as the distance from the vessel increases the pressures varying as the square of the corresponding velocities. They are greatest in a narrow channel where the area available for backward flow is restricted, while theory indicates that they are of necessity greater in shallow water in which flow takes place in layers approximately parallel to the surface, than in deep water where inflow and outflow may take place freely in vertical as well as in horizontal directions. When a vessel is propelled by its own screw the distribution of pressure is somewhat modified. The screw propeller, drawing a large volume of water from regions ahead and abreast of itself and throwing this astern, tends to increase the velocities of flow, to reduce pressures ahead, and to increase those astern of itself. When two ship-shaped bodies are moving in close proximity each affects the lines of flow and the distribution of pressure around the other. Those pressures between the hulls suffer the greatest modification, and it is this modification in the distribution of pressure over the two sides of each of the vessels which gives rise to interaction between the two. If one vessel is overtaking a second one on a parallel path the effect on the overtaking boat of the system of currents accompanying the leader is broadly as follows:—As the faster vessel draws up astern it first comes within the influence of the outflowing currents astern of the leader, and as the strength of these is greater at its bows it experiences a tendency to sheer off from the leader—Fig. 1*a*.

Creeping further ahead, its bows come within the influence of the inflowing currents while its stern is still being repelled, and it consequently tends to sheer in—Fig. 1*b*. This tendency generally becomes a maximum when the bow of the follower is a little abaft the beam of the leader, the exact relative position depending on the relative sizes and distance apart of the two vessels. If the follower passes this point in safety the tendency to inward sheer gradually diminishes until, when a little abaft the beam of the leader, it disappears and is replaced by a strong tendency to bodily inward drift—Fig. 1*c*. A further advance reduces the inward force on the bows and increases that on the stern, with a consequent tendency to outward sheer—Fig. 1*d*—which is increased

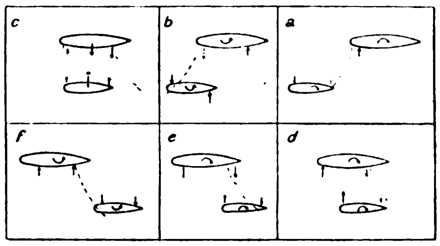


FIG. 1.

when, as in Fig. 1*e*, its bows come within the influence of the outflowing currents from the bows of the leader. Finally, as the follower draws ahead and becomes the leader, both bow and stern come within the influence of these currents, and, those at the stern being greatest, the stern is repelled more strongly than the bows, and the vessel tends to sheer inwards—Fig. 1*f*. The influence of the currents produced by the follower will, of course, be felt by the leader, and will tend to produce erratic movement on its part. The relative magnitudes of the various forces, and the exact point at which they change sign, varies with the relative sizes of the vessels and with their distance

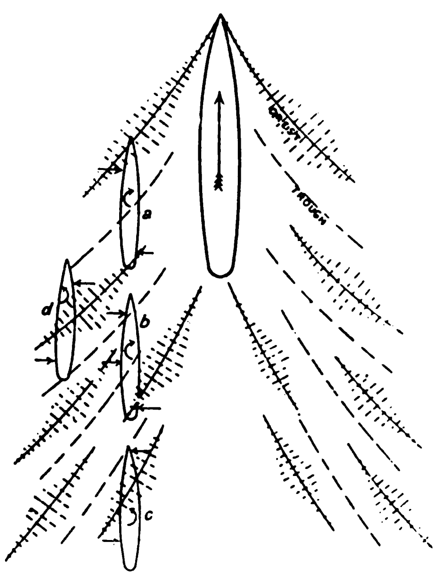


FIG. 2.

apart, but their general nature as regards direction and effect on both vessels with ships of the relative sizes and at the relative distances shown is indicated in the diagrams of Fig. 1. The arrows applied to the bow and stern of the vessels in these diagrams show the directions of the resultant forces at each point, and the curved arrows on each vessel indicate the direction of sheer under these forces. The curved dotted lines in the diagrams mark the boundaries between the regions of positive and negative pressure accompanying the leading vessel. If, instead of being parallel, the overtaking vessel is inclined to the leader in the position *b*—Fig. 1—the inflowing currents act more directly on its bows, and at a given distance their effect will be consequently increased.

Any ship-shaped body in motion is accompanied by a train of waves diverging from the bow and stern, and often, in addition, from some one or more points amidships, as indicated in Fig. 2, in which the full lines represent the crests and the dotted lines the troughs of the waves. The exact type of wave formation and the relative positions of crests and hollows with any given ship depend on its speed, and the modifying effect on a second vessel of the distribution of pressure set up by these, depends largely on the relative lengths and positions of the two vessels. Under the circumstances indicated in Fig. 2, however, the effect will be broadly as follows:—If the follower be at *a* the height of water at a given point on its port side near the bows is greater than at the corresponding point on the starboard side, with a consequent resultant pressure to starboard. Near the stern, however, the resultant pressure at corresponding points is to port, and as a result of these forces the vessel will tend to swerve in towards the leader. The same holds true if the vessel be in the position *b*, while in position *c* or *d* the reverse is the case. With a longer vessel in the same position relative to the leader, these actions would be modified and might indeed be entirely reversed, while at different speeds with a different wave formation the effects would also be different. In any particular case, however, these waves tend to modify the effect of the circulatory currents, increasing this in some positions and reducing it in others.

The difference due to this cause in the lateral forces over corresponding vertical elements of the hull is, however, not nearly so great as would be produced by the same statical differences of level, since the pressure at a given depth below the crest of a wave is less than at the same depth below the trough. At a given point in water through which a train of

waves is progressing the pressure becomes more nearly constant and equal to the pressure at the same point in the water at rest, as the depth of the point increases. With a vessel of draught so great that the vertical orbital motion of the particles at the level of its keel is negligible, the resultant lateral force over any vertical orbital motion of the particles deed be unaffected by the presence of the wave.

The deeper the water the greater is the vertical motion at a given depth accompanying a given formation, and the greater the resultant effect on a vessel of given draught. From this it appears that the wave effect is greatest in deep water, where the effect of interaction is otherwise least, and *vice versa*. That the result may be very appreciable with suitable relative lengths of ship and wave is evident when it is realized that a mean effective elevation of 1in. on the one side from bow to midships, and a mean elevation of the same amount on the other side from midships to stern of a vesesl 360 ft. long drawing 20 ft. of water, involves a sheering moment of the order of 1,500 foot-tons.

3.—*Experimental Results*

Diagrams 1 to 19—Figs. 3 and 4—show graphically the results of typical experiments in which the helm of the motor boat was lashed amidships. In the experiments shown in Diagrams 1 to 8 the speed of the Princess Louise was 5.1 knots; in those of Diagrams 9 to 13 it was 3.61 knots; while in those of Diagrams 14 to 19 it varied from 3.6 to 5.8 knots. The experiment shown on Diagram 1 shows the repulsion when the smaller boat is ahead of the larger, gradually changing into an attraction as the latter boat draws abreast, and finally producing collision from a lateral distance of 3.4 lengths of the smaller boat. Experiments 2 to 7 show the same attraction occurring at different relative longitudinal positions of the vessels, with lateral distances ranging from 1.7 to 3.5 lengths of the smaller boat. Initial repulsion is well marked in No. 8, in which the steam yacht Princess Louise is the faster vessel. Attraction, however, becomes apparent at a distance of three lengths when the vessels are approximately abeam, and is followed by collision in one minute. In the experiments 9 to 13 the speed of the Princess Louise was 3.61 knots. Experiment 9 is interesting as showing the vessels in relative positions in which, in spite of their close proximity, the resultant moment is approximately zero. Experiment 10, in which the Princess Louise is somewhat faster than the motor boat, shows the repulsion when the smaller boat is slightly ahead, changing to attraction as the larger boat draws abreast, and terminating in collision from a distance of one and a-half lengths. The repulsion is also well marked in Experiment 11, in which the motor boat is at first slightly the faster. In Experiments 12 and 13 the initial lateral distance is respectively one and one-third and one and two-thirds lengths, but the initial relative longitudinal positions are different in the two cases. In each case collision was produced. In Experiments 14 to 19—Fig. 4—the relative speeds were much greater than in the preceding cases. In Nos. 14, 15, 16, and 17 the speed of the Princess Louise was 3.75 knots while that of the motor boat was respectively 3, 9, 4.5, and 5.4 knots. In each case the experiment was commenced with the smaller boat in approximately the same relative position, viz., about two lengths laterally distant, and about a length astern of the leader, and in each case the smaller boat was attracted. In No. 14 the speed of the vessel was insufficient to allow of its catching up the Princess Louise before being drawn in, and it passed under the stern of the latter. In Nos. 15 and 16 collision took place, while in No. 17 the motor boat, although considerably deflected from its course, ran past the Princess Louise without collision. In Experiments 18 and 19 the speed of the motor boat was 3.9 knots, and that of the Princess Louise was 5.9 knots. At the beginning of both experiments the smaller vessel was clear of the bows of the Princess Louise, and at a lateral distance of 1.5 lengths in No. 18 and 2.0 lengths in No. 19. Under these circumstances it was drawn into collision in No. 18, while in No. 19 the Princess Louise ran ahead before the deflection of the course of the motor boat was sufficient to produce collision, the latter boat running under the stern of the Princess Louise.

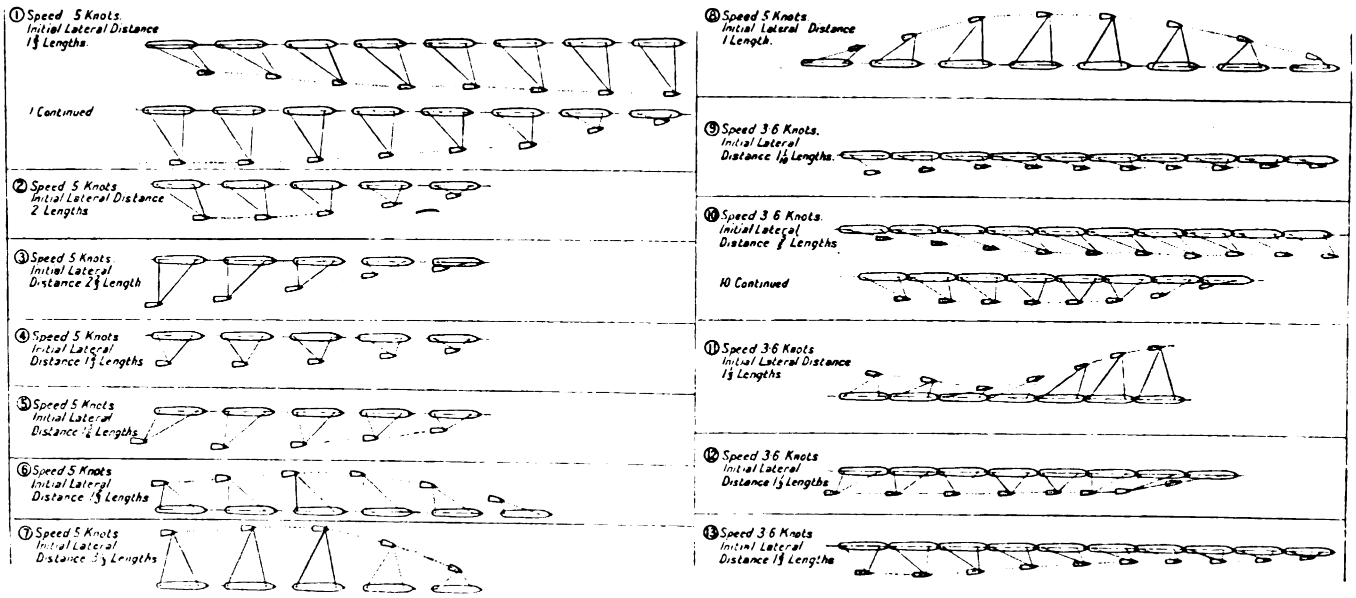


FIG. 3—SUCTION BETWEEN PASSING VESSELS

4.—*Magnitude of Moments and Forces Involved*

The authors would draw attention to the fact that collision, when produced by attraction from a comparatively large distance, is of a much more direct, and consequently danger-

ous, nature than when the paths of the vessels are initially very close. In the former case the forces involved are operative for a sufficiently long time, to produce a comparatively large angular deflection of the attacking vessel, the lateral component of whose own steaming speed becomes increasingly operative in increasing the velocity of approach. In the latter case the angular deflection is comparatively small, the velocity of approach is largely due to the bodily inward drift, and the vessels come together with a comparatively slight and innocuous broadside bump.

As previously indicated, the differences of the pressures obtaining at four corresponding equidistant points on the two sides of the smaller vessel were measured for different positions of this vessel, and the correponding lateral forces and pressures have been calculated on the assumption that the pressure varied uniformly between consecutive gages. Owing probably to the clogging of one or more of the pressure openings by floating material, some of the pressure observations gave obviously inconsistent results during the course of a run, and only those experiments have been included in which these observations were consistent throughout. Experiments 20 to 24—Fig. 4—are typical of these, and the relative positions of the vessels in these experiments are shown along with the magnitudes in foot-pound units of the corresponding moments (M) and lateral forces (F). Only during the latter portions of these runs were the various forces of sufficient magnitude to admit of reasonably accurate measurement by the method adopted, and only where those forces are greater than 10 lb. and the moments greater than 20 foot-pounds have these been given in the diagrams. Experiments 20 and 21 were carried out at a mean speed of 5 knots, and Experiments 22 to 24 at 3.61 knots.

The forces and moments acting on the smaller vessel depend on its lateral and longitudinal positions relative to the larger, and on the speeds of the two vessels. Under given speed conditions the sheering moment appears to attain its maximum value when the bows of the smaller are a little abaft of the beam of the larger vessel, the position of maximum sheer apparently receding slightly as the lateral distance increases, while when the bows are in line the force and moment are approximately zero. A further advance of the smaller boat is accompanied by an outward force and moment, with consequent repulsion of this vessel.

Both forces and moments diminish rapidly with an increase in lateral distance. For distances between one-half and three lengths the results show that the moment diminishes very approximately as the square of the lateral distance. Theoretical considerations indicate that forces and moments should increase with the square of the speed of the vessels. Actually in the experiments the rate of increase was slightly less than this. Since the turning moment exerted by the rudder is proportional to the square of the speed, it follows, as was noted in the helm control experiments, that the vessel is somewhat more easily controlled against suction forces at high than at low speeds.

Calculations show that the control-

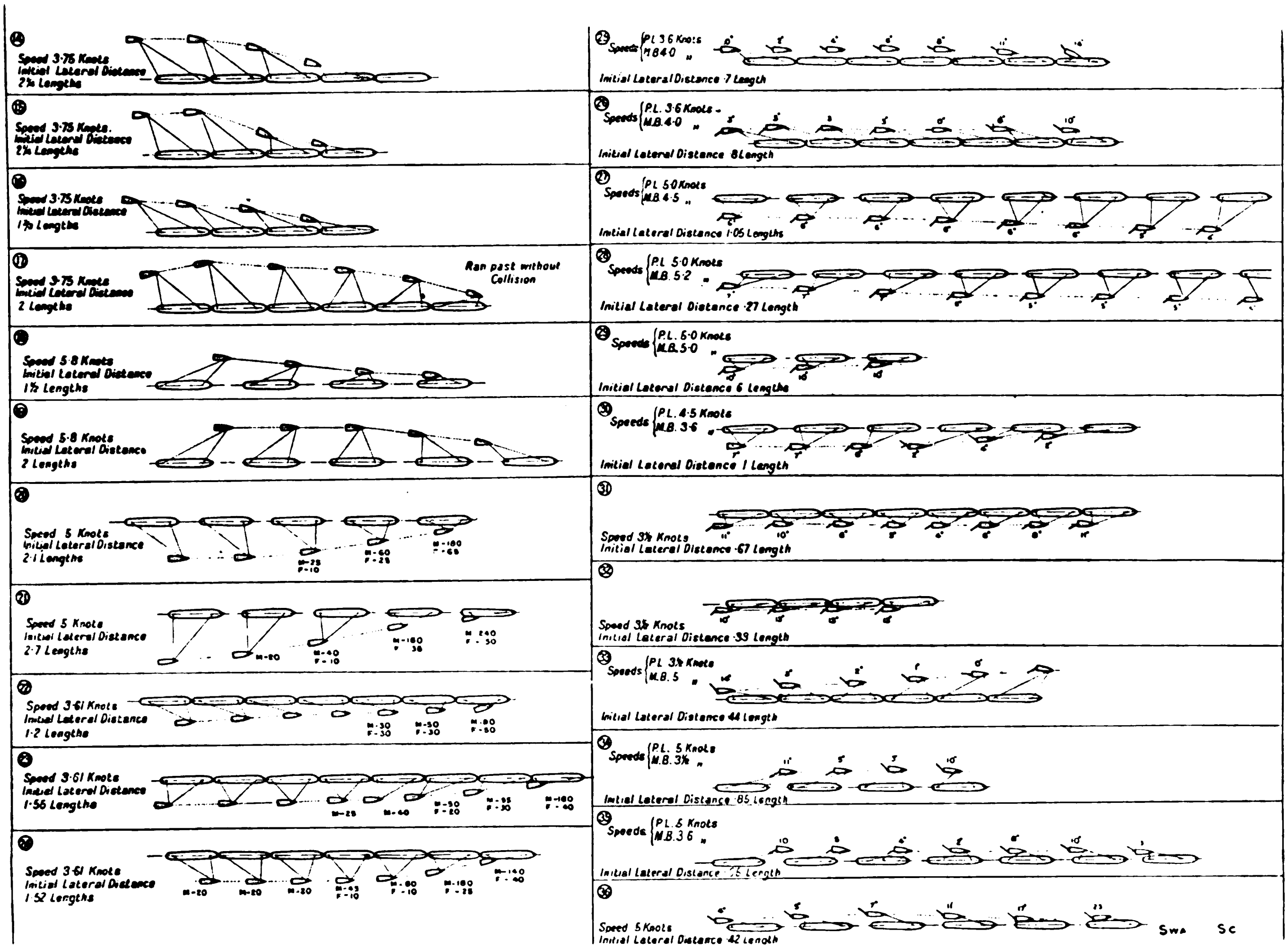


FIG. 4.—SUCTION BETWEEN PASSING VESSELS

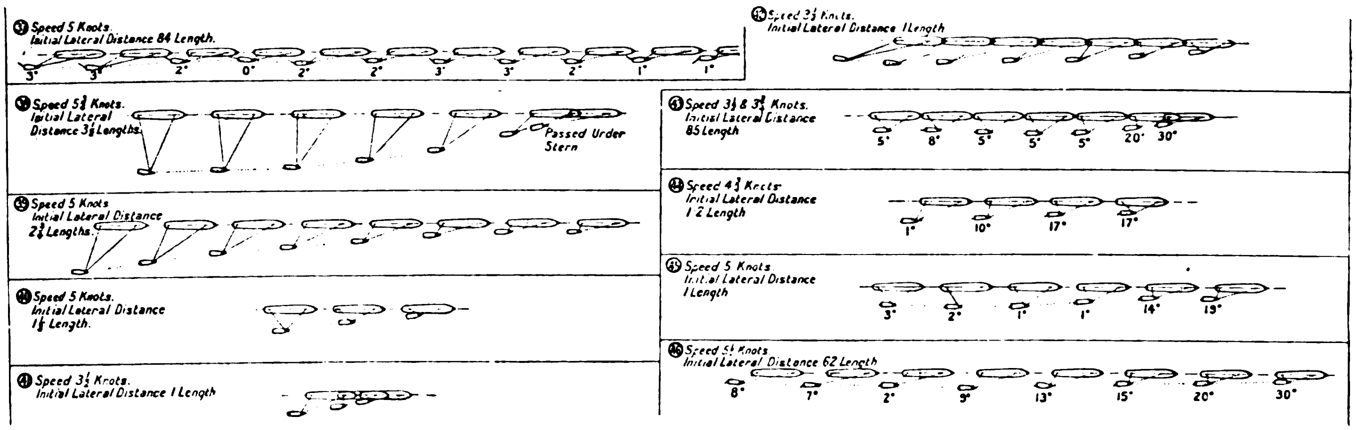


FIG. 5—SUCTION BETWEEN PASSING VESSELS

ling moments of the rudder in use during these experiments—area 1 ft. square—are approximately as f olllows (measurements in foot-pounds):

Speed (knots	Helm Angles. 5 deg.	10 deg.	15 deg.	20 deg.	25 deg.
5.0	100	180	280	340	400
3.6	 52	93	145	175	210

From these figures it appears that the maximum moments measured in the experiments, viz., 240 foot-pounds at 5 knots and 160 foot-pounds at 3.6 knots, are such as would be controlled by helm angles of about 13 deg. and 16 deg., while when at a lateral distance equal to one length of the smaller boat, and in the position of maximum sheer, the helm angle for control would be approximately 8 deg. at 5 knots and 9 deg. at 3.6 knots. These values are very sensibly confirmed by the results of the helm control experiments.

5.—*Helm Control Experiments.*

In the first helm control experiments a rudder having an area of 1 square foot was used on the motor boat. While considerably less than the rudder originally fitted to the boat, this has an area proportionately about 100 per cent greater than is usual in high-speed sea-going vessels. It was anticipated that the effect of this would be to diminish the helm angle necessary for control by about the same percentage as compared with a large vessel under similar conditions, and with a view of testing this point a smaller rudder of 75 square inches area was afterwards fitted, and was used in a further series of trials. In each run the helms were manipulated so as to keep both vessels as near as possible on parallel courses, heading for the same distant point. Typical results of experiments with the large rudder are shown in Diagrams 25 to 30—Fig. 4—and with the smaller rudder in Diagrams 31 to 37. In these diagrams the speed of each vessel, the helm angle for each position of the motor boat, and the direction (port or starboard) of the helm, has been indicated.

An examination of the results shows that, as indicated by the gage observations, the maximum sheer is experienced when the bow of the smaller is a little abaft the beam of the larger vessel. The angle diminishes rapidly as the lateral distance between the vessels increases, and when these are moving at the same speeds (5 knots), and are at a lateral distance equal to one length of the smaller vessel, has a maximum value of approximately 6 deg. with the larger and 9 deg. with the smaller rudder. At a lateral distance of one-half length this increased to about 10 deg. with the larger and 14 deg. with the smaller rudder.

It should be noted that in these trials all initial tendency to swerve was at once corrected by the helm, and was, in fact, anticipated as far as possible. Where such a sheer has once been initiated, and the vessels are travelling on convergent paths, a much greater helm angle is necessary to restore the attracted vessel to its original course. In experiments in which the helm was kept amidships until the two vessels were within one-half length of each other, the angle necessary to prevent collision with the larger rudder was approximately 17 deg. at 5 knots and 23 deg. at 3.6 knots. It will thus be seen that twice the amount of helm angle is necessary to prevent collision if the boat has once commenced to sheer in. The experiments indicate that, on the whole, the smaller vessel is under better control at the higher than at the lower speeds.

Diagrams No. 34 and 35—Fig. 4—are interesting as showing the comparatively large helm angle required to prevent an outward sheer when the smaller is ahead of the larger vessel, whilst Nos. 26, 30 and 37 show the (smaller) angle required to prevent outward sheer when the larger has drawn well ahead of the smaller vessel. The effect of a variation in the relative speeds of the vessels is well marked in Experiments 33 and 34 In the former the smaller at 5 knots is passing the larger vessels at 3.6 knots, with the result that when a little abaft the beam of the latter vessel and at a distance of one length 2 deg. of helm is sufficient for control. In No. 34 the larger vessel at 5 knots is passing the smaller at 3.6 knots and when in the same relative position 10 deg. of helm is necessary for control. When both are moving at the same speed an angle of approximately 7 deg. is necessary in this position. It follows that any attempt of the larger vessel to draw ahead of the smaller by increasing the speed greatly increases the risk of collision. A somewhat surprising feature of the results is the comparatively small difference between the control exerted by the two rudders when under the influence of interaction. In the open the difference in their effect, as shown by the difference in the two turning circles, was very apparent, and the difference in the two sets of conditions is probably largely due to the fact that when in the vicinity of the larger vessel, the greater turning moment of the larger rudder is partly masked by the more rapid inward drift consequent on the greater lateral pressure on its surface.

The Tendency to Sheer

There is reason to anticipate that the tendency to sheer, as opposed to bodily drift, would be greater with an attracted vessel of greater relative dimensions than that used in the experiments. This vessel is in a field of force whose intensity varies from point to point, and which, consequently, gives rise to both a resultant force and a couple. The average magnitude of the force per unit area

of the side of the vessel depends solely on the mean intensity of the field extending from stem to stern, and is therefore largely independent of the length of the vessels. It follows that the resultant force is increased in the same ratio as the area of the vessel, and with similar vessels in the ratio of the squares of corresponding linear dimensions. Since the weight of the vessel is increased in the ratio of the cubes of such dimensions, the resultant force per unit of mass of the vessel increases directly as the inverse of the linear dimensions, and, consequently, the smaller the attracted vessel the more rapid will be its inward drift. On the other hand, as the size of this vessel is increased the differences between the forces exerted at bow and stern become greater, and the resultant couple is increased in a greater proportion than the resultant force. As a consequence, the smaller the attracted boat the less relatively is its tendency to turn inwards about its own axis. With a very small boat collision when it does occur is mainly due to the inward drift; the velocity of lateral approach is low, as it is only slightly affected by the steaming speed of this vessel, and the resultant impact is at a comparatively small angle. This conclusion receives some confirmation from the results of experiments on 20 ft. models of equal size by Naval Constructor D. W. Taylor, of the United States Navy. In these experiments the models were attached to a carriage and were towed at the same speed. They were maintained in definite relative positions during a run, and the lateral forces required at bow and stern to prevent swerve were then measured by spring dynamometers. A comparison of these results with those of the authors' shows that the proportional reduction in the resultant lateral force with the two small but equal vessels is much greater than the reduction in the sheering moment.

6.—Effect on an Increased Draught of the Attracted Vessel

With a view of determining the effect of an increase in the draught of the attracted vessel an additional series of experiments has been carried out during the past few weeks. For these a deeper keel was fitted to the motor boat, increasing its mean draught from 1.37 ft. to 2.87 ft. without sensibly affecting its displacement.

Diagrams 38 to 42—Fig. 5—show the results of typical experiments on the vessel with the helm amidships, Nos. 38 to 40 being carried out in deep water and 41 and 42 in water having a depth of about 12 ft. A comparison of Nos. 38 and 39 with Nos. 7 and 3—Fig. 3—which are very similar as regards speed and lateral distance, appears to indicate that the effect of the increased draught is slight, and that collision is produced within about the same time in each case. This is, however, to be qualified by the fact that in runs 38 and 39 the vessel was exposed to a breeze on the port bow equivalent, as was shown afterwards, to a helm of about 3 deg., so that, in effect, in these two experiments a constant helm of roughly this amount was tending to keep the vessels apart. In Experiment 40—compare No. 4, Fig. 3—the smaller vessel was under the lee of the larger, and in this case the attraction is notably greater than in the deeper water, although the difference was not very pronounced.

Diagrams 43 to 46—Fig. 5—show the results of helm control experiments in which the same rudder, 1 square foot area, was used as in Experiments 25 to 30—Fig. 4. A comparison of these two sets of experiments shows that the helm required to prevent swerve is very appreciably greater with the deeper keel—about twice as great, in fact, as with the shallow keel under otherwise similar circumstances. At equal speeds (5 knots) at a lateral distance of half a length in the position of maximum sheer, a helm angle of about 17 deg. is necessary to prevent sheer as against 10 deg. with the shallow-keeled vessel, while where the helm is kept amidships until within this distance a helm of 35 deg. was sometimes insufficient to prevent collision.

General Conclusions

In general the greater the difference between the speeds of the vessels the smaller is the risk of collision, since such a difference reduces the time during which the mutual forces are operative, such an effect being much more marked when the smaller vessel is the faster. If the larger vessel is the faster, particularly if her speed be accelerated while passing the smaller, the attractive forces are increased to an extent which partially, and in some cases entirely counterbalances the effect of the reduction in the time during which the vessels are in dangerous proximity. It follows that any attempt of the larger vessel to draw ahead of the smaller by increasing her speed, while in close proximity, greatly increases the risk of collision.

With vessels of the relative size used in these experiments, moving at speeds within 10 per cent of each other, collision may be produced from a lateral distance as great as 3½ lengths of the smaller vessel, except in so far as prevented by helm action. The greater the draught of the attracted vessel for a given displacement and length the greater the probability of ultimate collision. The smaller the attracted vessel within limits the smaller is the angle of impact under given conditions, while the greater the lateral distance from which collision is produced the more direct and dangerous is the resultant impact.

On the whole, the results of the trials show that under cetrain circumstances interaction is a very real danger to navigation, even in deep and open waters. With ordinary vessels of the relative sizes adopted for the experiments, if the possibility of interaction is realized from the very first, and if all initial swerve is prevented by an early application of the helm, there would appear to be little danger even at lateral distances so small as one-half the length of the smaller vessel, but once such a swerve has been initiated a much greater helm angle is necessary to control the vessel, and, failing immediate control, collision occurs within comparatively few seconds.

Retirement of J. Bruce Ismay

The retirement of J. Bruce Ismay from the office of president of the International Mercantile Marine Co. on June 30 necessitated a reorganization in the management of the White Star Line at Liverpool and in its constituent companies, the Oceanic Navigation Co., Ltd., the British and North Atlantic Steam Navigation Co., Ltd., and the International Navigation Co., Ltd. Mr. Ismay is succeeded by H. A. Sanderson, who was admitted into the partnership of Ismay, Imrie & Co. in 1900. New managers have been appointed in H. Cancanon, E. Lionel Fletcher and A. B. Canty. The New York office is not affected, but remains under the general management of P. A. S. Franklin, vice president of the company. The retirement of Mr. Ismay also involves the closing of the firm of Ismay, Imrie & Co. after forty-five years successful operation. This is in accord with an agreement made with the late J. Pierpont Morgan that this firm's name should no longer be used upon Mr. Ismay's withdrawal from active service.

Geared Turbine Steamers

Results of the Trials of the Curzon, Elgin and Hardinge

IN its last issue THE MARINE REVIEW published a brief description with drawings of the grand turbine steamers Curzon, Elgin and Hardinge. The results of their trials were given in a paper by J. Inglis before the Institution of Naval Architects in London in June, in which he said:

The following paper is offered in response to a suggestion from Dr. Archibald Denny during the discussion on Sir Charles Parson's paper read at the spring meetings. Dr. Denny expressed a wish to have the results of the trials of three small vessels fitted with geared turbines, but at that time these trials were incomplete.

The vessels are named Curzon, Elgin, and Hardinge, after three viceroys of India, and are intended to connect Ceylon with the Indian mainland by a short sea passage in smooth water, instead of the long and occasionally disagreeable voyage which hitherto has been the only available means of transit.

The South Indian Railway Co., owners of the vessels, applied for guidance to the late Sir William H. White, who furnished them with an outline design of the internal arrangements and a specification covering all the requirements of the service, at the same time leaving the builder a very free hand as to the form of the vessel, scantlings of material, power of propelling machinery, and other details.

Sir William White's foresight was evinced by the fact that the whole contract has been completed without any alterations on the working plans or any extra changes of importance. The vessels are 250 ft. long by 38 ft. broad, and displace about 865 tons on 6 ft. draught of water. The principal conditions of the contract were that the vessels should carry 160 tons of dead weight on a draught of water not exceeding 6 ft., and, while so loaded, be capable of steaming 20 sea miles at the rate of 16½ knots, starting from rest, no allowance being made for the time occupied in getting under way. The fuel used on trials was to be as nearly as possible equivalent in heating power to the Indian coal available on service, a sample analysis being furnished, which showed 63.26 per cent of fixed carbon. The coal actually used contained 63.86 per cent of fixed carbon, being a rather poor sample of Scotch coal, but almost exactly what was wanted. Yarrow boilers were fitted, the heating surface being 7,000 sq. ft., and the grate 168 sq. ft. The boilers were arranged to be fired with oil if that should be found advantageous. It will be observed that the actual full speed to be attained was not stated in the conditions, nor were any data available whereby it might be computed. It was considered safe to assume 17 knots, and estimates were made on that basis, as, if 17 knots could be maintained for 19 miles, there would be left one mile of distance and over five minutes of time to attain full speed. This was deemed to be sufficient. A preliminary trial of the Curzon was made on Dec. 10 last, to test the working of the turbines, and, the weather being very calm, advantage was taken of the divisions on the measured mile in the Gareloch to learn something about the acceleration of a vessel starting from rest. The results are shown on the diagrams.

Fig. 1, above, shows, on a base of one nautical mile, the time for each fraction of a mile and the increasing speed during acceleration.

Fig. 2 shows, on a base of speed in nautical miles per hour, the revolutions of propellers, the slip in knots and the slip per cent during accelera-

Fig. 1 T.S.S. "CURZON" DOTTED CURVES BY TANK TRIAL FULL CURVES BY OBSERVATION

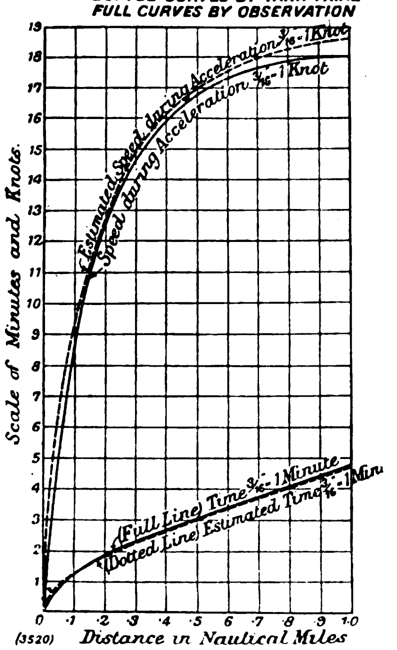


Fig. 2. T.S.S. "CURZON" CURVES ON SPEED BASE

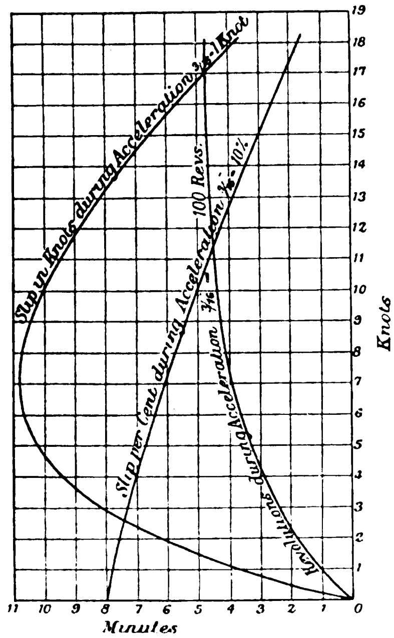
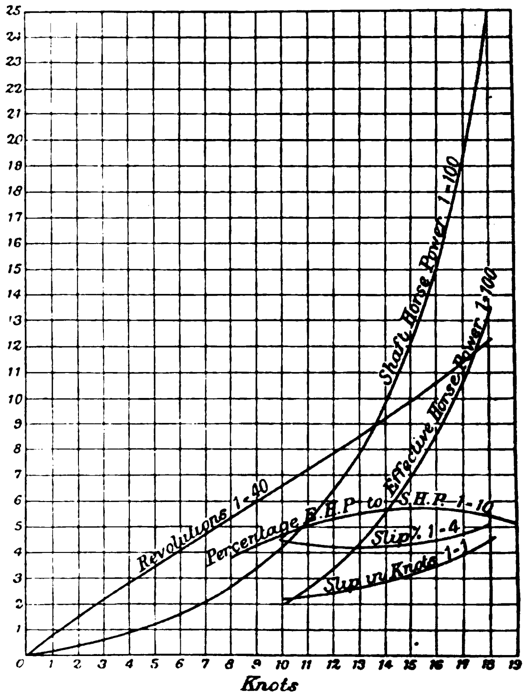


Fig. 3 PROGRESSIVE TRIAL RESULTS.



tion.

Fig. 3 shows the revolutions, slip, and shaft horsepower during a progressive trial of the Elgin, also the effective horsepower (which Messrs. Denny were so kind as to ascertain for us in their experimental tank), and the ratio of effective to shaft horsepower.

Computed Speed

The dotted curves on Fig. 1 show the computed speed during acceleration, also the time required to run one mile starting from rest. These were constructed by Mr. Mumford, superintendent at Messrs. Denny's experimental tank, from calculations based on the resistance of the model. The agreement between the curves constructed from calculations made on a model and those from experiment on a full-sized ship is extremely close. If Mr. Mumford is present, I hope he will tell us how this clever piece of work was done. The 20 miles distance, starting from rest, was steamed by the Curzon in 65 minutes, equal to a mean speed of 18.46 knots, the tide being with her for the first half and against her for the second half, the wind fresh, about three points abaft the beam. The time occupied by the Hardinge was 66½ minutes, equal to 18.045 knots, she having a stiff breeze against her and a weak tide in her favor, high water at Greenock being about 8 o'clock on that day. It was not considered necessary to repeat this trial with the third vessel, and instead of this a progressive trial was made on the measured mile, and a run of two hours at high speed was utilized in measuring the water consumption. During the latter the revolutions were somewhat reduced by a strong head wind, the average being 482.8 per minute, corresponding to a speed of 17.8 knots. The mean shaft horsepower was 2,390, and the consumption of steam, for turbines only, 12.55 lb. per hour per shaft horsepower. The consumption of steam by the auxiliaries amounted to nearly 3 lbs. per hour per shaft horsepower of main engines. Among the auxiliaries are reckoned the engine driving a large dynamo, and the steam steering gear. The temperature of the feed was 205 deg. Fahr. The air pressure in the stokehold did not exceed ¼ in. of water column.

An attempt was made to record the noise of the gearing on a new phonograph obtained for the purpose, but, although the sound of the engine room telegraph gong and some vocal efforts were clearly rendered by the instruments, the sound of the gearing could not be recognized amidst the scraping of the reproducer on the wax cylinder.

Prof. Biles, in his interesting remarks on Sir Charles Parsons' paper, quotes a ship-owning friend repelling the suggestion to permit the innovation of "cog-wheels" in a passenger steamer's propelling machinery.

The use of cog-wheels cannot be regarded as a novelty, even in high-class ocean-going passenger steamers. I can remember the building, in 1855, of the steamer Oneida, which was then deemed large, seeing that only 25 steamers of the same or greater register tonnage were on the Mercantile Navy List at that date. This vessel was 307 ft. long by 39 ft. beam. Her gross tonnage was 2,284, and her net register 1,372 tons. Her engines were direct-acting, but the results were so unsatisfactory that before she was two years old—that is, 1857—she was put into our hands to undergo certain alterations and receive new geared engines of about 3,000 horsepower. These engines, cog-wheels and all, appeared to work satisfactorily for 17 years, though I fear they could not have been remarkable for economy of steam, and in 1875 she was converted into a sailing ship. Thirty years later, being then 50 years old, she disappeared from the British register, having found a new owner in Chili. High speed of piston being somewhat of a bugbear to engineers in the 'fifties, geared engines were common enough in channel and coasting steamers, and even Robertson's frictional gearing, where the wheels and pinions had grooves in place of teeth, was not unknown in marine work.

What was tolerated 60 years ago, with cast iron pinions and mortise wheels, might surely be adopted now with the refined methods of gear-cutting which Sir Charles Parsons and others have made available.

Dry Dock in Canal Zone

The first train load of rock to be placed in the construction of the cofferdam for completing the excavation for the dry docks at Balboa in the dry, was dumped July 5. Balboa is to be the Pacific port of entry for the canal zone. The large docks and its approaches are to be excavated to a depth of 45 feet below mean sea-level, and a large part of the site of the approaches is at present under water. The completion of the cofferdam will allow the area to be pumped out, and made accessible to steam shovels.

The cofferdam is to extend from the southwest end of the sand wharf, opposite the Sixth Division's floating landing for small launches and pangas, to the site of the old coal wharf of the Panama railroad. It follows an approximately elliptical curve, about 1,350 ft. long, subtended by the present shore line. Its construction consists essentially of two railway trestles, separated by a distance of 15 ft. between inside rails, between which will be dumped a core of earth, to be armored with rock dumped outside the trestles. The driving of trestle began on April 2, from the sand wharf. It is now almost completed, with a piledriver working outward from the other end; a gap of 100 ft. will be left as long as practicable, to allow the passage of vessels to the shipways and repair shop of the Sixth Division.

This construction has necessitated the removal of the old coal wharf and the construction of a new pocket beyond the site of the cofferdam. The new pocket was erected on the site of the wharf which collapsed on August 17, 1912, when the steamship Newport sank. The dredging landing was also moved, to a point just east of the new coal pocket.

The Imperator's Figurehead

The monster eagle of bronze on the bow of the Hamburg-American liner Imperator has a greater significance than serving to perpetuate the time-honored custom of figureheads. The Imperator's eagle has in fact four eyes. Two of these are in the usual place above the curved fighting beak and the two additional eyes or glass openings are placed in the breast of the big bronze bird. Within the eagle, in order that his two window eyes may be used for the benefit of the big ship, a lookout is constantly stationed. This lookout keeps a veritable eagle's watch on the sea for dangers to the ship in the shape of wreckage, icebergs, or other vessels, warning of which he sends immediately by telephone to the ship's officers, so that he need never turn his head from scrutinizing the ocean. Every four hours there is a shift on the interior of the eagle. The mere man lookout is changed. But the Imperator eagle? He never slumbers and he never sleeps.

The Mallory Line has given contract to the Newport News Ship Building & Dry Dock Co., Newport News, Va., for two freight and passenger steamers, for service between New York and Galveston. They will be 432 ft. long, 54 ft. beam and 33 ft. 9 in. molded depth.

Motor Ship Suecia

The Trials of the Vessel Show the Diesel Engine to be an Economical Prime Mover

By I. Knudsen

IN the autumn of 1911 the Rederiaktiebolaget Nordstjernan Co., of Stockholm, ordered six motor liners from Messrs. Burmeister and Wain, the firm with which I am connected, the dimensions of the vessels being as follows: Length, 362 ft.; breadth, 51 ft. 3 in.; and depth, 34 ft.; carrying capacity, 6,500 tons dead weight.

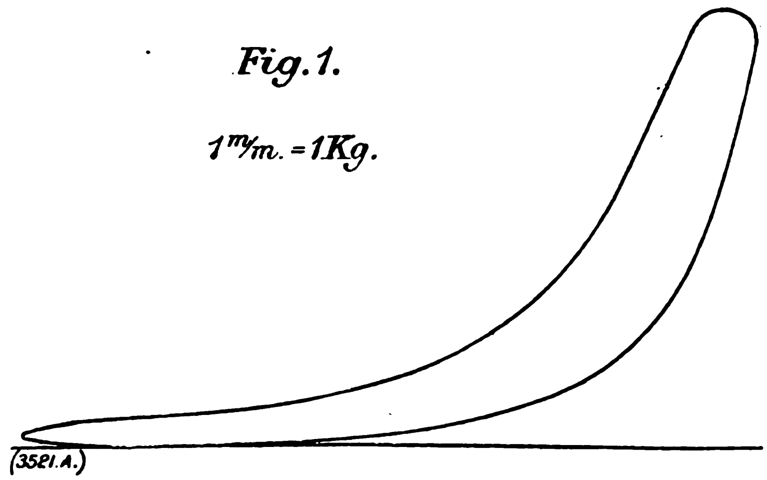
The machinery consists of two main engines, each of 1,000 indicated horsepower (four-cycle Diesel engines with eight cylinders), besides two auxiliary Diesel engines each of 200 effective horsepower for working the compressors, auxiliary machinery (such as winches and steering gear), and for the production of the electric light; the machinery is in other respects similar to that of the Selandia, which was described by the author in a paper read before the Institution last year.

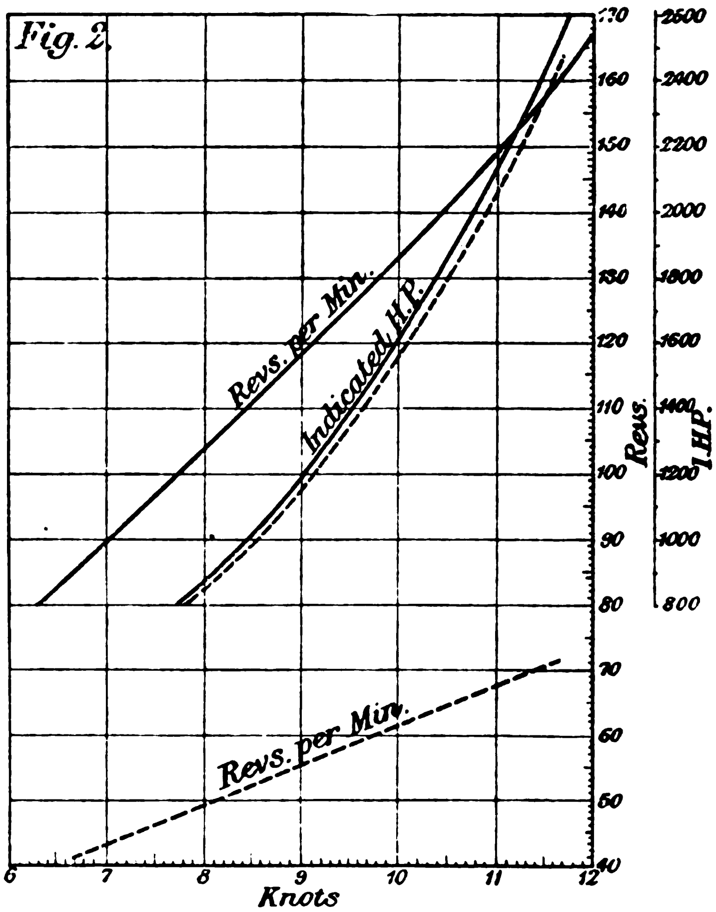
Passenger Quarters

As to passenger accommodation, there are only eight cabins for first-class passengers, which is much less than is provided for in the Selandia; the cabins, however, are roomy and modern, and provided with bath and toilet rooms. Further, there is ample saloon accommodation, and a hospital. The Suecia is intended for the Sweden to La Plata service, and she will be chiefly employed for cargo purposes, being fitted with the most modern loading and discharging gear, such as double derricks and double winches.

The vessel was launched on Nov. 2, 1912, and the trial trip took place on Dec. 17, 1912. The next day she went to Limhamn, where she took in a cargo of 15,000 barrels of cement, then she sailed to Stockholm, where —as far as I know—cargo of 4,000 was taken in. On Dec. 23 she left for Gothenburg, and here she took in still more cargo, and left on Dec. 31, arriving at Christiana on Jan. 1, where her cargo was completed, and on Jan. 4 a trial trip took place in the Christiana Fjord with the vessel fully laden. When the trial trip had been completed, she went to London, where she arrived on Jan. 9, and went from London to Rio Janeiro, arriving at that port on Feb. 1.

I will refer to certain matters concerning the Suecia owing to some remarks made in the discussion of the paper which was read before the Institution of Naval Architects, to the effect that no information was given with regard to the efficiency of the propellers, etc., compared with that of ordinary steamers. The reason why no such information was given in connection with the Selandia was, that with this vessel no trial trip took place with the ship fully laden, and





M.S. "SUECIA" (Full Lines)
362'0"x51'3"x23'0" (Draught)
D.W. 6500 Tons.
Coefficient 0·78
(3521 B.)

SS. "PRINCESSAN INGEBORG" (Dotted Lines)
360'0"x48'9"x22'4" (Draught)
D.W. 5895 Tons
Coefficient 0·794

consequently we possessed no comparative results. With the Suecia, however, we succeeded in carrying out this trial trip in Christiana Fjord, and I am glad to have this opportunity of publishing the results.

The full lines on Fig. 2 give the curves showing the indicated horsepower, the number of revolutions, and the speed obtained with the Suecia. The dotted lines on this figure give similar particulars obtained with the Princessan Ingeborg, a vessel built a few years ago for the same owners, but fitted with steam engines.

No Difference in Power

As appears from the dimensions given on these diagrams, the vessels are almost alike, both in dimensions and also with regard to the fineness of lines. If the two vessels are compared, it will be seen that to obtain the same speed for the same displacement the same indicated horsepower is required, whether it is to be used in the motor liner or in the steamer. According to this result there seems to be no difference in the power required to propel a vessel, whether this is effected by means of a single large slow-running propeller, as in the steamer, or by two relatively fast-running small propellers, as in the motor liner. The propeller in the steamer has a diameter of 17 ft. 6 in., and in the motor liner of 10 ft. In this respect it must be remembered that in the Suecia the main Diesel engines do not work the pumps, nor the two first stages of the air compressors. The relation of the indicated horsepower to the brake horsepower of the engines will, therefore, be about the same as in a steam engine, and the combined efficiency of the mechanism of the engines and of the propellers is about the same as obtains with the steam engine.

The weight of steam installation in the Princessan Ingeborg brought up to correspond with the horsepower of the motor installation amounts to 570 tons, as an extra main boiler was fitted in view of the cleaning of the boilers. The total machinery in the motor ship Suecia weighs 470 tons. With regard to the space occupied by the engines in the Suecia, this is 41 ft. of the length of the vessel, whereas it is 66 ft. in the Princessan Ingeborg, although the horsepower as stated above is less in this vessel.

It should be stated that the trial trip took place under good conditions, such as fine weather and deep water. The vessel, however, has now returned from her maiden voyage, and from the speed attained on the Atlantic the comparative trial trip results seem to hold true in the practical performance of both vessels.

In the trial trip in Christiana Fjord the oil consumption per indicated horsepower was measured, and a result was obtained which no doubt is the best hitherto obtained—viz., 134 grammes (0.295 lbs.) of oil per indicated horsepower hour, measured on the main Diesel engines, and when everything is allowed for, such as the consumption of the auxiliary engines, etc., the oil consumption per indicated horsepower of the main Diesel engines amounts to 154 grammes (0.339 lbs.), including the fuel oil necessary for the working of the auxiliary engines, steering engines, pumps, etc., but exclusive of the oil used for heating the vessel. The mechanical efficiency of Diesel engines of the type used, but with the whole of the compression of the air necessary for fuel injection performed by the engines themselves instead of by auxiliaries, has been shown by bench trials to be 80 per cent, so that the oil consumption per brake horsepower of such a marine Diesel engine would amount to 167½ grammes (0.369 lbs.) per brake horsepower.

The diagram, Fig. 1, which was taken during the trial trip, shows by its shape and appearance that the engine is extremely economical.

The Siam, which was recently built for the East Asiatic Co., was, until now, the biggest sea-going motor liner; her length being 410 ft.; her carrying capacity, 9,200 tons; and the horsepower, 3,000. It may, perhaps, be of interest to follow the development of motor liners, and I may add, therefore, that at present the following vessels have been ordered from my firm, besides those already delivered:

One motor liner similar to the Siam, 410 ft. long, with engines of 3,000 horsepower, for the East Asiatic Co.

Five motor liners referred to above, similar to the Suecia, for the Rederiaktiebolaget Nordstjernan.

One vessel, 405 ft. long, carrying capacity 7,500 tons, with engines of 2,500 horsepower, for the United Steamship Co., of Copenhagen.

To replace the Fionia, which was sold to the Hamburg-Amerika Line, we are constructing for the East Asiatic Co. a motor liner, 390 ft. long, with engines of 4,000 horsepower. This company has also ordered from us four other vessels, each with a length of 410 ft., with engines of 4,000 horsepower.

All the figures given of the horsepower are exclusive of the auxiliary Diesel engines.

July Ore Shipments

Notwithstanding the delays in the early part of the month, the ore movement passed the 8,000,000-ton mark, being the first time in the history of the trade that this figure has been reached. The actual movement was 8,204,416 tons. The total movement to August 1 was 24,329,460 tons, and in order to reach the 50,000,000-ton mark it will only be necessary for the fleet to move from now on the same amount that it did during the corresponding period last year. Obviously it can do this with ease as stages of water are contributing considerably to the carrying capacity of the vessels. The shipments by ports were as follows:

Port.	July, 1912.	July, 1913.
Escanaba	836,346	858,696
Marquette	511,924	496,725
Ashland	771,057	754,329
Superior	2,324,324	2,396,064
Duluth	1,540,324	1,938,716
Two Harbors	1,616,258	1,759,886
	7,600,233	8,204,416
1913 increase		604,183

Port.	To Aug. 1, 1912.	To Aug. 1, 1913.
Escanaba	2,478 294	2,659,299
Marquette	1,430,814	1,556,501
Ashland	2,103,858	2,264,031
Superior	6,668,655	7,073 413
Duluth	4,385,802	5,934,664
Two Harbors	4 223,481	4,841,552
	21,290,904	24,329 460
1913 increase		3,038,556

Hugo P. Frear, associated with the Union Iron Wrks, San Francisco, has been called east by Charles M. Schwab to inspect the plans for ten ore-carrying vessels intended to be used in carrying ore from the Chilean mines to the Bethlehem Steel Corporation, South Bethlehem, Pa.

The Turner Brass Works, Sycamore, Ill., has recently put out a gasoline blow torch for general use, such as burning paint, thawing out frozen piping, drying and baking sand molds and many other uses. It is about 5 ft. long, of heavy gage brass tubing, 2 in. in diameter, with a powerful burner at one end and gasoline valve and pressure pump at the other.

Mr. Greensmith, formerly in charge of the machine department of the Newport News Ship Building & Dry Dock Co., has taken charge of the machine department of the Skinner Ship Building & Dry Dock Co., of Baltimore, Md. G. P. Stephens, formerly of the W. & A. Fletcher Co., Hoboken, N. J., has taken charge of the boiler department of the Skinner Ship Building & Dry Dock Co.

New London Ship & Engine Co.

Description of the Plant in Which the First Heavy Oil Engine of the Diesel Type Was Built in This Country

THE manufacture of heavy oil engines of the Diesel type for marine use is almost entirely limited in this country to the New London Ship & Engine Co., Groton, Conn. A few other concerns are interested in the manufacture of this product, but their efforts are still confined, more or less, to the experimental stage. At Groton, however, these motors are turned out on a commercial scale.

The New London Ship & Engine Co., although formed only a little more than two years ago, represents the materialization of plans that had their inception more than a decade before that. At about that time certain officers of the Holland Torpedo Boat Co. thought it would be advisable to provide that concern with a yard of its own, since it would not then be under the necessity of sub-letting its contracts. A number of obstacles, however, made it necessary to postpone action on this project.

FRANK T. CABLE
Vice President and General Manager of the New London Ship & Engine Co.

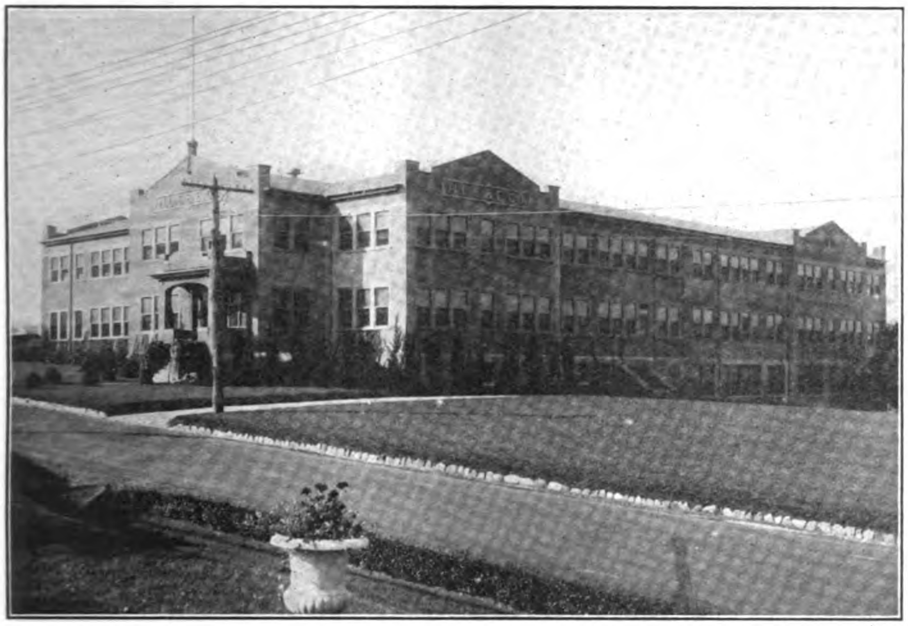
Several years ago the Electric Boat Co. was organized and this company took over the Holland Torpedo Boat Co., and several smaller concerns. The officers of the Electric Boat Co., who had devoted considerable time and effort to the development of gas engines in large units, came to the conclusion in 1908, that the time was about ripe for the introduction of heavy oil engines in this country and it was thought practicable to build the yard which had been under consideration for so many years, and equip it for marine machine work, in connection with the manufacture of Diesel engines. Frank T. Cable thereupon went to Germany in 1909 to study the manufacture and operation of these motors and when he returned he brought back with him the American manufacturing rights to the type of Diesel engine developed by the Machinenfabrik, Augsburg, Nuremburg. The success of his mission and the favorable report submitted by Mr. Cable soon led to the formation of the New London Ship & Engine Co.

That company was organized on Oct. 11, 1910, with an original capitalization of $500,000. Construction work was commenced in November of that year and by July, 1911, the buildings were completed and manufacturing operations gotten under way. Before the company really got started, however, an increase in capital was decided on and the original $500,000 was increased to $3,500,000, the present figure. It is interesting to note that all of this stock was sold for the full par value of $100 per share, and all of this money was turned into the treasury without the payment of any commissions. Dividends of 8 per cent have been paid on this stock since the day the shop was opened. The company has no bonded indebtedness.

The plant, as originally completed, consisted of an office building, a two-story shop, 100 x 165 ft., with a pattern-shop and store-room adjoining. Six months later it was found necessary to increase both the shop and office facilities. The shop now has a total length of 380 ft., one portion being 100 by 280 ft., and the other 130 by 100 ft. The pattern-shop and storehouse is two stories, 60 by 70 ft. Thus the present plant has a floor space of approximately 65,000 sq. ft. The plant represents the most advanced type of factory construction and it is the finest establishment for marine machine work of all kinds in the world.

The new administration building which is situated on the summit of a hill overlooking the factory and the country for miles around, is 40 by 100 ft., and two stories in height at the front, with a three-story extension, 35 by 125 ft., at the rear. It is occupied jointly by the New London Ship & Engine Co. and the Electric Boat Co.

The establishment of the plant at Groton was the most important event in the industrial history of that community for many years and its coming was heartily welcomed by the citizens of both New London and Groton, who subscribed for stock and built homes for the workmen and made other necessary provisions. The plant is situated on the bank of the Thames river immediately opposite New London and this location is ideal in all respects, since the company not only has its dock on the edge of deep water, but is provided with adequate railroad facilities as well. Including the foremen, the New



ADMINISTRATION BUILDING OF THE ELECTRIC BOAT CO. AND THE NEW LONDON SHIP & ENGINE CO., GROTON, CONN.

London company now has a force of 380 men at work, without taking into account the office force or the molders employed in the foundry. The company operates in two shifts, the night shift working 12 hours and the day shift nine hours. The foundry, which is a new and modern building, is located under lease on the New London company's property, and is owned and operated by the Vanadium Metals Co. The entire output of the foundry is taken by the New London company.

Only Marine Type Developed

The New London company's rights to the manufacture of heavy oil engines in this country entitle it to take up the marine, stationary and traction fields. Only the marine department has been developed up to the present, since this end has absorbed the entire present capacity. It is planned to further extend the plant later on so that the capacity may be enlarged for the production of engines for these other fields. There have been built or are building in the plant engines of various capacities totaling some 15,000 horsepower.

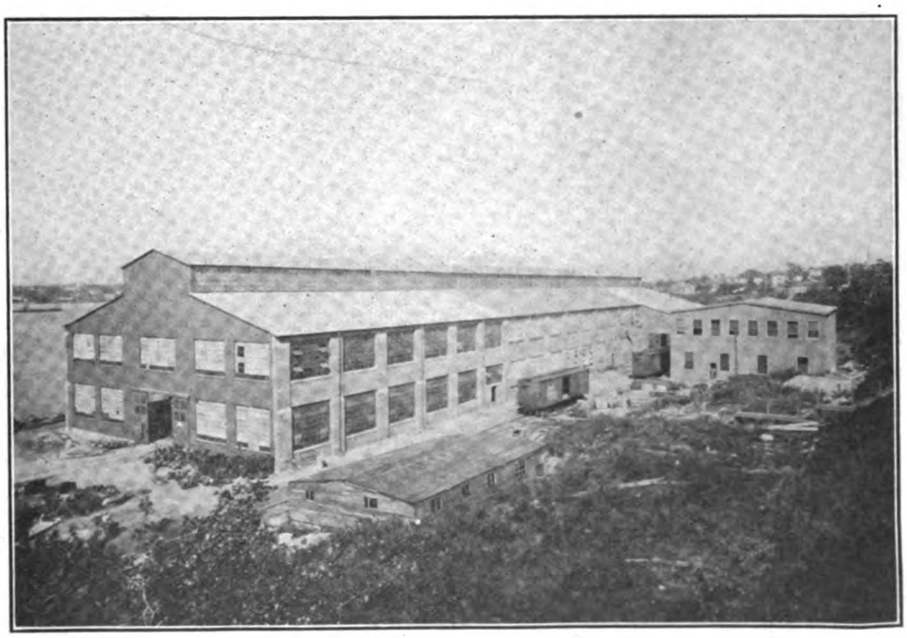
The first heavy oil engine of the Diesel type to be built in this country was completed by the New London company in the summer of 1912. It was a 150-H. P. unit and was installed on the yacht Idealia, owned jointly by the Electric Launch Co., Bayonne, N. J., and the New London Ship & Engine Co. This is the first and only American yacht today propelled by a Diesel engine. The first American built Diesel engine to be installed for commercial use was a 300-H. P. engine built by this company and put into service on board Standard Oil barge No. 62. These, as well as the other engines built by the company, are operating satisfactorily.

In addition to the manufacture of Diesel engines, the New London company has a favorable manufacturing contract under which it supplies not only the engines, but most of the other machinery and equipment for the submarine boats constructed by the Electric Boat Co. for various governments. The company is now equipping with Diesel engines and other machinery, 21 submarine boats for the United States navy; the contract for five of these boats has just been awarded and three of these on an earlier contract have already been delivered. The company is also building a part of the machinery for two submarines for the Russian government. It is also building the equipment for a submarine tender to be provided with a 900-H. P. Diesel engine. The annual output of the company at the present time is approximately $800,000 and this will be materially increased when the extensions just completed receive their equipment.

The executive personnel of the New London Ship & Engine Co. is made up of men who are in the prime of life, and all of them have had wide experience with the modern internal combustion engine, as well as in various branches of marine engineering. Their able and aggressive management is reflected in the fact that within two years from the time the company was incorporated, capital was procured, shops and administration buildings erected at a cost of almost $500,000 and work amounting in value to just under $500,000 was turned out.

The steamship Catalina was launched on July 19 at Cramp's yard, Philadelphia. This is the third vessel building at the yard for W. R. Grace & Co., New York, and is intended for trade via the Panama canal.

The Fumigating & Fire Extinguishing Co. of America, 29 Broadway, New York, recently fumigated the fleet of the Panama Railroad Steamship Line.



MACHINE SHOP OF THE NEW LONDON SHIP & ENGINE CO., GROTON, CONN.

Self-Propelling Barges

A Producer Gas Proposition Which is Working Out Well in the Black Warrior District

IN its issue for August, 1912, THE MARINE REVIEW announced that the Great Lakes Engineering Works of Detroit had received an order from the Alabama-New Orleans Transportation Co., for fifteen self-propelling steel barges to ply between the Black Warrior coal basin in Alabama and New Orleans through Black Warrior, Tombigbee and Mobile rivers, Mississippi Sound and Lake Borgne canal.

A shipyard for the construction of the barges was erected on Lake Borgne canal, about ten miles north of New Orleans. As soon as it was equipped construction work began. Three of these barges have now been launched and the fourth is on the stocks. No. 1 has been in commission for some little time and barge No. 2 is approaching completion. The enterprise is a totally new one and the barges will traverse a waterway of about 515 miles

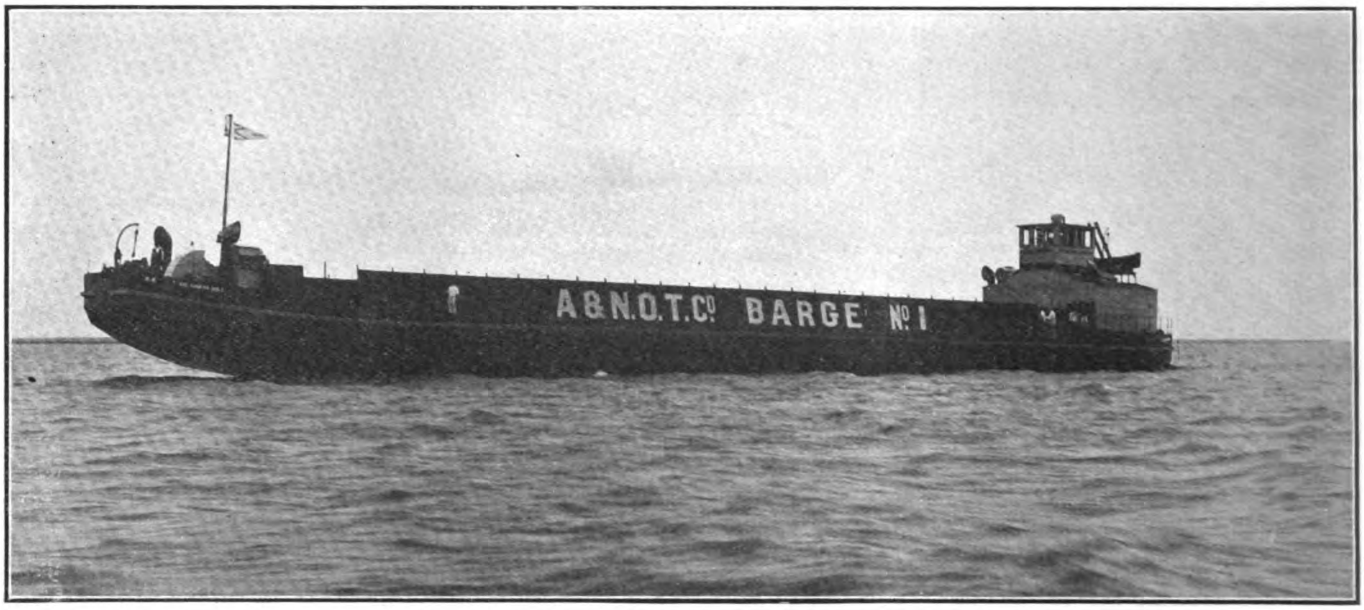


FIG. 1.—SHOWING BARGE NO. 1 ON HER TRIAL

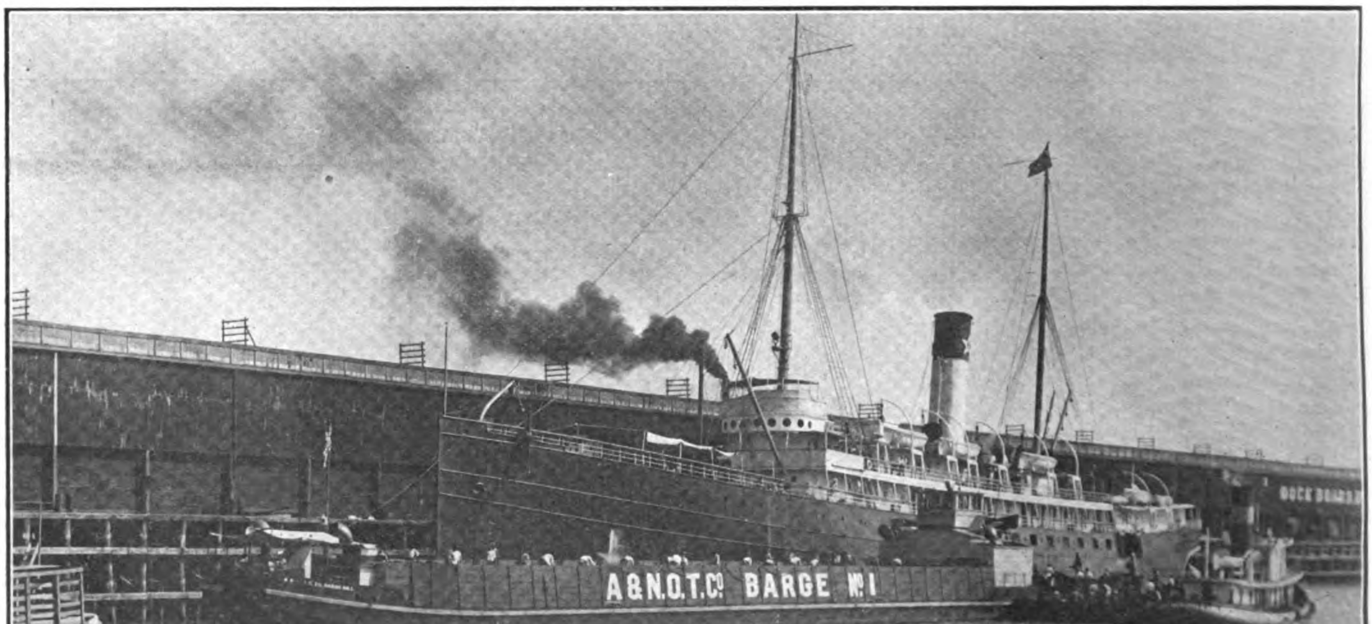


FIG. 2.—BARGE NO. 1 UNLOADING A CARGO OF ROSIN INTO A ~~MALLORY~~ LINE STEAMER AT NEW ORLEANS

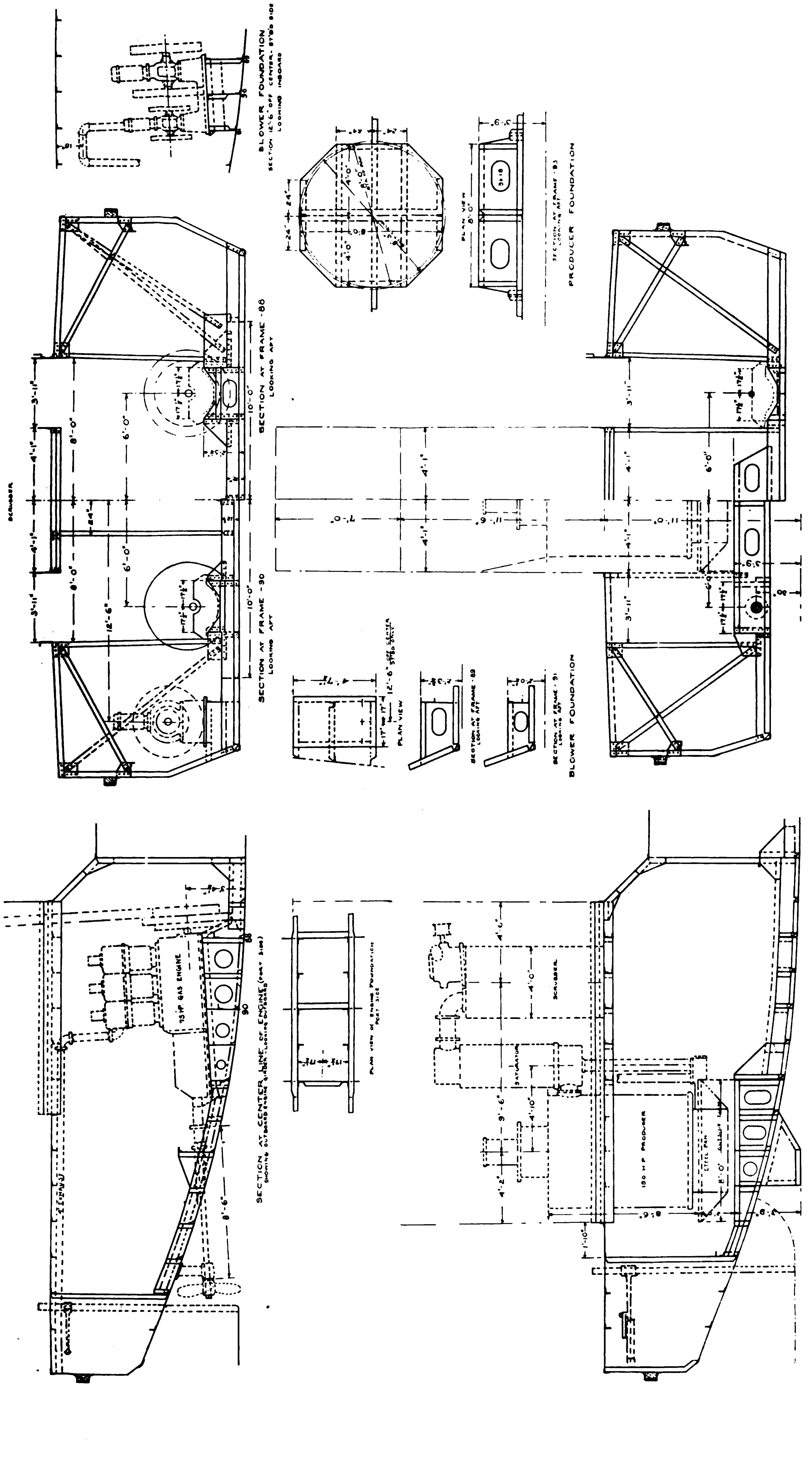


FIG. 3.—SECTION OF CENTER LINE OF ENGINE AND SECTION AT CENTER LINE OF SHIP

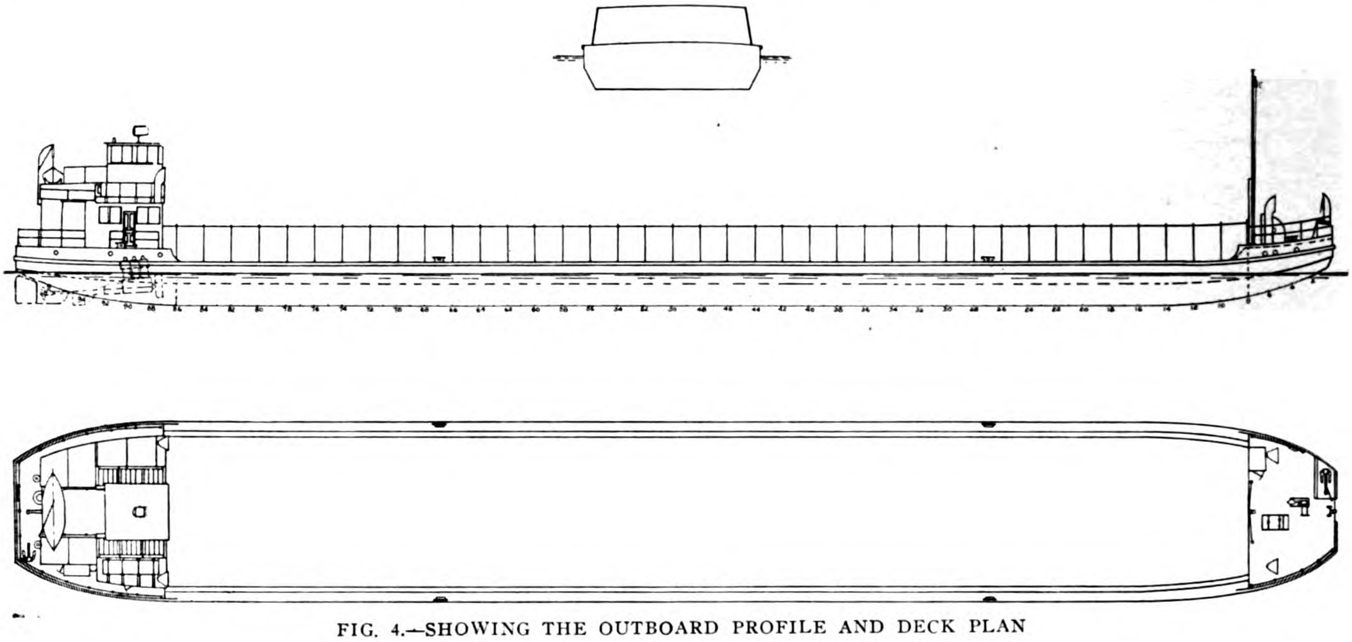


FIG. 4.—SHOWING THE OUTBOARD PROFILE AND DECK PLAN

in length, upon which during the past twenty years the federal government has spent nearly $8,000,000 in making the channel navigable. The mines in the Black Warrior basin produce about 6,000,000 tons of coal per annum, which is now being hauled by rail to New Orleans at a cost, including switching and terminal charges, of about $1.30 per ton. The intention is to make the water rate $1.20 per ton, which it is expected will show a good profit. The return cargoes will probably consist of scrap iron and Cuban ores. The dimensions of the barges are:

Length, 240 ft.
Beam, 32 ft.
Depth, 8 ft.

Their construction is entirely of steel with one bulkhead aft of the forecastle and one forward of the engine room. They have no hatches as they are designed to carry the load on deck. The entire crew is berthed in the forecastle and both galley and pilot house are placed aft.

The propelling machinery consists of two 3-cylinder marine gas engines, each of 75 B. H. P., driving right and left-hand propeller wheels made of semi-steel, 46 in. diameter, 2 ft. 9 in. pitch, and the developed area of blades being 6.67 square feet. The engines are designed to develop the horsepower at a maximum speed of 300 revolutions. The gas producing equipment consists of a gas producer with the usual saturator, scrubber and tar extractor, the gas producer being hand fired. The fuel used is what is known as coke breeze, of which there is practically an inexhaustible supply in the Birmingham district. Coke breeze is the waste coke from the coke ovens and consists of very fine particles of coke which cannot be used ordinarily in commercial practice. Hitherto it has been regarded as pure waste. Experiments demonstrated, however, that it makes a splendid fuel when used in a gas producer. The total cost of supplying the engines with producer gas averages about $2.00 in twenty-four hours, being about sixteen times more economical than oil.

One of the gas engines is connected by friction wheels to a 5-in. ballast pump and the other engine is arranged to drive in a similar manner a small electric generator. An auxiliary gasoline engine is carried to furnish power for the electric generator when the vessel is in port. There is also a small air compressor for supplying the necessary air for starting the main engine. The windlass is electrically driven. The barge is hand-steered and

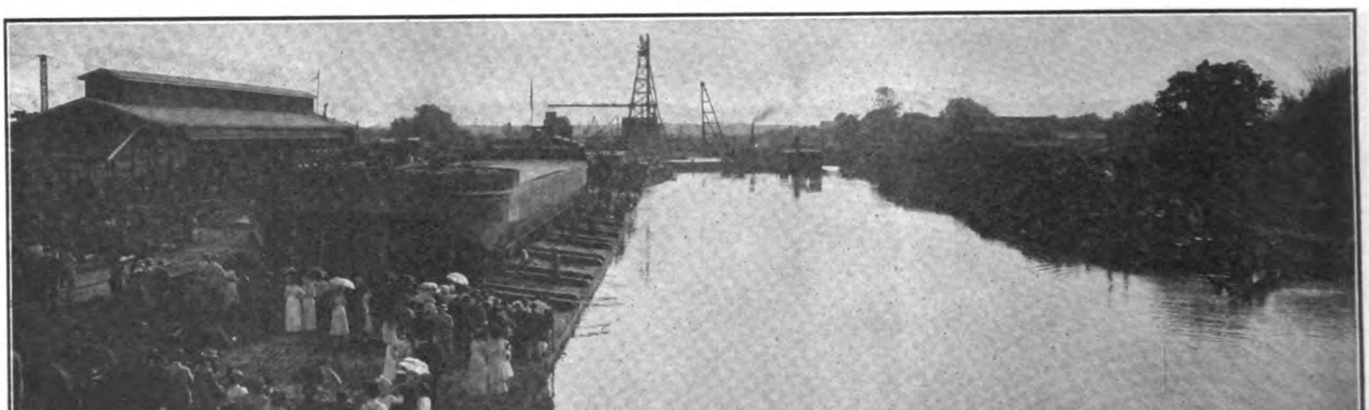


FIG. 5.—THE SHIP YARD ON LAKE BORGNE AND BARGE NO. 3 ON THE STOCKS

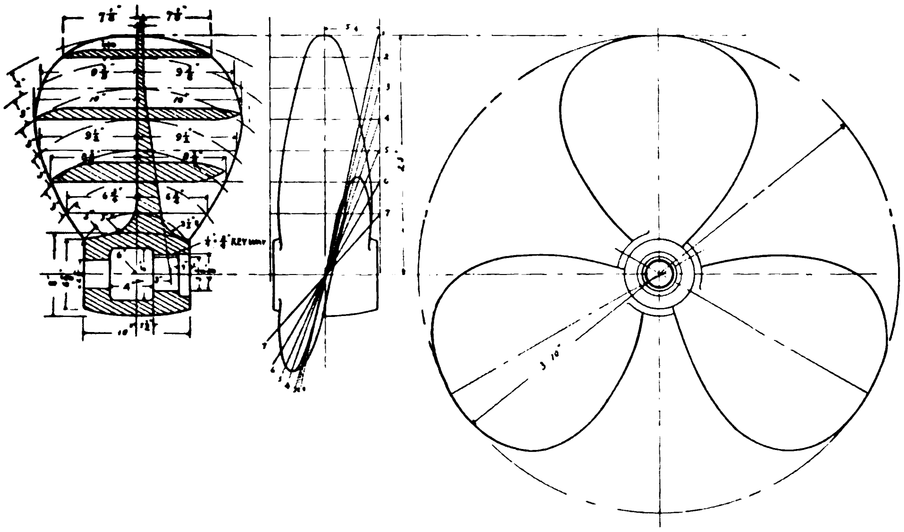


FIG. 6.—LEFT HAND PROPELLER

one small capstan aft is also worked by hand, this style of equipment being all that is necessary for the particular trade in which the barges are employed. Barge No. 1 has proved on trial to be very easy to steer.

The general arrangement of hull and design of machinery are shown in the accompanying drawings. Fig. 1 gives a very good illustration of the general outline and appearance of the barge. Fig. 2 shows the barge discharging a cargo of barreled rosin into one of the Mallory Line steamers at her dock in New Orleans. This load of rosin was taken on to try out the barge. On this trip the barge made an average speed of 8½ miles per hour. The maximum speed obtained on the trip was 8.9 miles per hour, the conditions as to wind being normal.

The barges are designed to carry 1,000 tons on a draught of 6 ft. and are warranted to have a working speed of seven miles an hour. Fig. 3 gives the section at center line of engine, section of center line of ship, showing the gas producer located between the two engines in the engine room. The athwartship section reveals the general shape and construction. Fig. 4 shows the outboard profile and deck plan.

A considerable amount of study and experiment was given to the question of propeller wheels and great care was given to accuracy of pitch and absolute running balanced condition. The details will be found in the drawings herewith. Fig. 5 shows barge No. 3 on the stocks ready for launching with the usual launching party in attendance. Barges No. 4 and 5 are now under construction and now that the experiments have been made and have proved satisfactory, the intention is to push construction work with the idea of finishing a barge every four weeks.

Handling Lead Slag

Confronted with the problem of handling large quantities of lead slag and other waste material in a rapid and economical manner, the Belbach Smelting & Refining Co. has found the solution in the installation of an interesting conveying plant at its works, located on Newark Bay, N. J. After the smelting plant at this location had been in operation for some time, it was decided that more meadow-land in its vicinity should be filled-in to provide for future building sites. An abundance of material for filling was at hand in the form of ore, slag and other waste, which it was necessary to dispose of constantly at the various plants of this company. At first the slag was dumped on scows and towed to the Newark site. Here the scows were moored in a slip and wagons were filled by hand.

An unloading plant was erected which consists of a mast and gaff rig which operates a clam shell bucket with an ore bowl of 1⅝ cubic yards capacity, which dumps into a hopper. This plant was furnished by the Hayward Co., 50 Church street, New York. The plant has proved both economical and speedy. Only an engineer and a boatman are employed and a speed of two loads a minute has been attained.

The bucket is operated by a rope passing around the large power wheel. The pull upon this rope closes the blades and, as the hoisting continues, the bucket is raised, and by means of the automatic swing, it is quickly carried to a position over the hoppers, where it discharges. The radius of the swing is 30 ft. The mouth of the hopper is 24 ft. square and it has a capacity of 300 to 400 cubic feet. The clearance for the wagons is 11 feet. The automatic movement of the gaff is controlled by two lines. These ropes pass over the sheaves at the peak of the gaff and then to two sheaves on the cross tree arm at an equal distance from the mast, which is 32 feet high. This spread of the mast in connection with their loads is the fundamental principle of the automatic swing. To place a loaded bucket over the hopper, the closing line takes most of the load from the time it digs until the bucket opens into the hopper. To return the bucket over the scow, the holding line fastened to the head of the bucket takes the load. A winch head moves the scow under the bucket. The builders do not recommend the clam shell bucket for iron ore as its physical condition is not as favorable for rapid handling as the lead slag.

Capt. Horace Wilson, president of the Wilmington Steamboat Co., Wilmington, Del., has been appointed a member of the board of water commission of Wilmington.

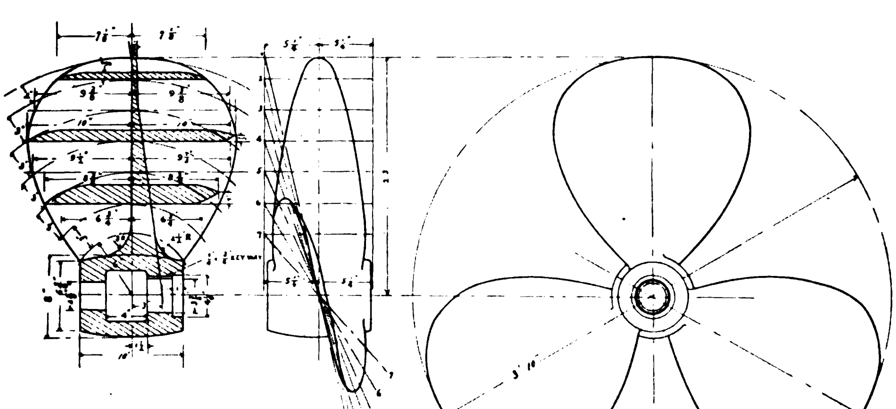


FIG. 7.—RIGHT HAND PROPELLOR

THE MARINE REVIEW

DEVOTED TO MARINE ENGINEERING, SHIP BUILDING AND ALLIED INDUSTRIES

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Safety at Sea

Of course, the Titanic disaster was such an overshadowing calamity that in considering safety of life at sea it immediately springs uppermost to the mind; but nevertheless actual figures prove that the sea is a very safe place to be on in a modern vessel. In the period extending from 1892 to 1911 some 95,000 passages were made between Great Britain and the United States, carrying 350,000 crew and 9,390,000 passengers. Out of this very large number of trips accidents involving loss of life occurred in only 155 cases, involving 1,056 members of crews and 80 passengers. Only one out of 332 of the crews and one out of 117,400 passengers did not reach their destination safely. Of the 1,137 souls which so perished, 39 were lost in seven cases of foundering, 187 in ten strandings, 9 in six cases of collisions, and 195 in 113 cases of accidents on board due to bursting of steam pipes, explosions, gas, fire or other causes. No fewer than 707 were lost in 29 vessels which were posted as missing. Owing to this very large proportion in missing vessels, it is impossible to definitely analyze the cause of death. These figures are well to ponder over, because they really make out a very good case for the ship.

The Titanic disaster was an exceptional case and was due to an unusual combination of circumstances which probably will never occur again in the history of steam navigation. Many precautions, however, have since been adopted by the leading steamship lines to minimize the danger resulting from any similar accident, though the great ocean liners that have been constructed since that disaster would not be mortally injured were they to meet with a similar misfortune. Subdivision of hull into separate watertight compartments has been given very serious consideration since that event. An absolutely unsinkable ship is impossible. All that can be done is to limit the space into which water can find access, so as to reduce the amount of sinkage and to insure that the bulkhead deck will still be well above water. Limitations to the extent of flooding may be imposed by transverse, longitudinal or horizontal subdivision, but obviously there is a limit to the extent to which it is possible to subdivide a merchant ship which is primarily intended to earn money.

On passenger ships the question of subdivision is largely one of convenience versus safety. If the vessel is elaborately subdivided it means that passengers have to do a great deal of stair climbing in the lower decks. Convenience must be sacrificed both by crew and passengers when elaborate subdivision is attempted.

Steamship companies have latterly been impressed with the necessity of carrying life boat provision for all on board. In our opinion, this has been carried to excess, but nevertheless they appear to be all committed to it. The new German vessel Imperator has actual life boat equipment for 5,000 persons, which is 300 more than she will ever carry, including crew. Whether these ships could all be safely got into the water and whether they could live after they were launched is another matter. The real safety of the ship unquestionably lies in careful navigation, supplemented by a stanch and well-driven hull.

The question of life boats and their character has been under consideration by the Boats and Davits Committee of the British government for the better part of a year and their final report has just been made. Briefly put, its most important recommendations are as follows:

The number of persons to be allotted to any open life boat is to depend upon its stability and upon its actual capacity as determined by Stirling's Rule, instead of upon the over-all dimensions and an assumed coefficient.

Development may safely be in the direction of larger boats, say 50 ft. by 15 ft. by 6 ft. 8 in., each carrying 250 persons and weighing 28 tons when loaded.

Decked life boats to have permanent bulwarks fitted with buoyancy tanks; they may be "nested" two or three deep, even although it may be necessary to raise them out of the nest by means of hand-winches before they can be moved under davits.

Pontoon rafts may be accepted for 25 per cent of the persons for which the ship is certified.

In foreign-going ships the life boats are to be transferable to either side.

Davits to have gearing to turn the boat out even against a considerable list. To have non-toppling

blocks or two sets of falls if they deal with more than one boat, and wire falls with lowering drum and brake if with more than two boats.

Power boats to be optional; in any case not more than two will be necessary on each side of the vessel; their radius of action to be 100 miles on paraffine fuel.

The World's Leading Port

New York City is not only the greatest commercial center of the United States, but the greatest port in the world, according to the latest statistics of the value of the imports and exports which have passed through 10 of the largest ports of the world. These figures, which have been gathered by the Industrial Bureau of the Merchants' Association, are the latest available on the commercial activities of the 10 cities mentioned, those for New York representing the close of the fiscal year ending June 30, 1913, and they give New York a supremacy over London of nearly $200,000,000. The figures are:

1.	New York	$1,973,981,693
2.	London	1,791,857,641
3.	Hamburg	1,674,187,176
4.	Liverpool	1,637,280,476
5.	Antwerp	1,121,654,799
6.	Marseilles	678,431,300
7.	Havre	531,096,600
8.	Bremen	501,146,540
9.	Buenos Ayres	479,536,241
10.	Calcutta	410,128,830

New York City has today more than five times the amount of commerce which was carried on by the entire country a half century ago.

It is pointed out that the striking character of New York's supremacy as the new center of the world's trade is shown by the fact that with the opening of the Panama canal New York will be 1,600 miles nearer Yokohama than Liverpool; 2,500 miles nearer Sydney, 4,000 miles nearer Wellington, and 2,574 miles nearer Valparaiso. Since Liverpool is practically 500 miles nearer those ports than either Bremen or Hamburg, the significance of the New York location is emphatic.

New York City, after the opening of the Panama canal, will be nearer to the Asian, Australasian, South American and many of the African markets than any of the great European ports.

Imports and Exports

The foreign trade of the United States for the month of June and for the complete fiscal year ending with that month surpasses all previous records. It represents a very gratifying total, but the foreign trade of other countries has also advanced in large proportion. There is special interest in the comparison of the foreign trade of the United States with that of the United Kingdom, which has a mere fraction of its area and only about half of its population.

The value of our imports for June was $130,848,803, while the value of British imports for the same month was about $290,000,000, or considerably over twice that of American imports. As a manufacturing country, Great Britain is an enormous importer of materials and obviously being manufacturing must depend upon other countries for its agricultural supplies. The exports for June from the United States amounted to $163,282,677, but Great Britain, though distinctively an importing country, exported products in June valued at about $210,000,000, which is an increase of $39,000,000 over the same month last year, and nearly $47,000,000 in excess of those of the United States, which usually prides itself on being an exporting country, though why it should be a matter of pride in the exchange of commodities with other countries to be sending away more value than we are bringing back, is not altogether clear. Great Britain, of course, has a restricted home market, whereas the great market of the United States is the home market —the greatest market, in fact, in the world.

Beautifying the Panama Canal

President Wilson has sent to congress a report by the commission of fine arts outlining a plan for beautifying the Panama canal. This includes two monuments and impressive architectural features at the entrance. Daniel C. French, the New York sculptor, and Frederick Law Olmstead, landscape architect, of Boston, spent two weeks on the Isthmus and the report submitted is based on their recommendations. The commission does not find the canal construction work to be of architectural beauty. "The entire absence of ornament and no evidences of the aesthetic," is one of the phrases describing the work on the canal. This, however, the commission admits, was to be expected of a work that was to be "strictly for utility. Like the Pyramids, it is impressive because of its scale and simplicity," observes the commission. "Anything done merely to beautify would have been an impertinence in a work of that character."

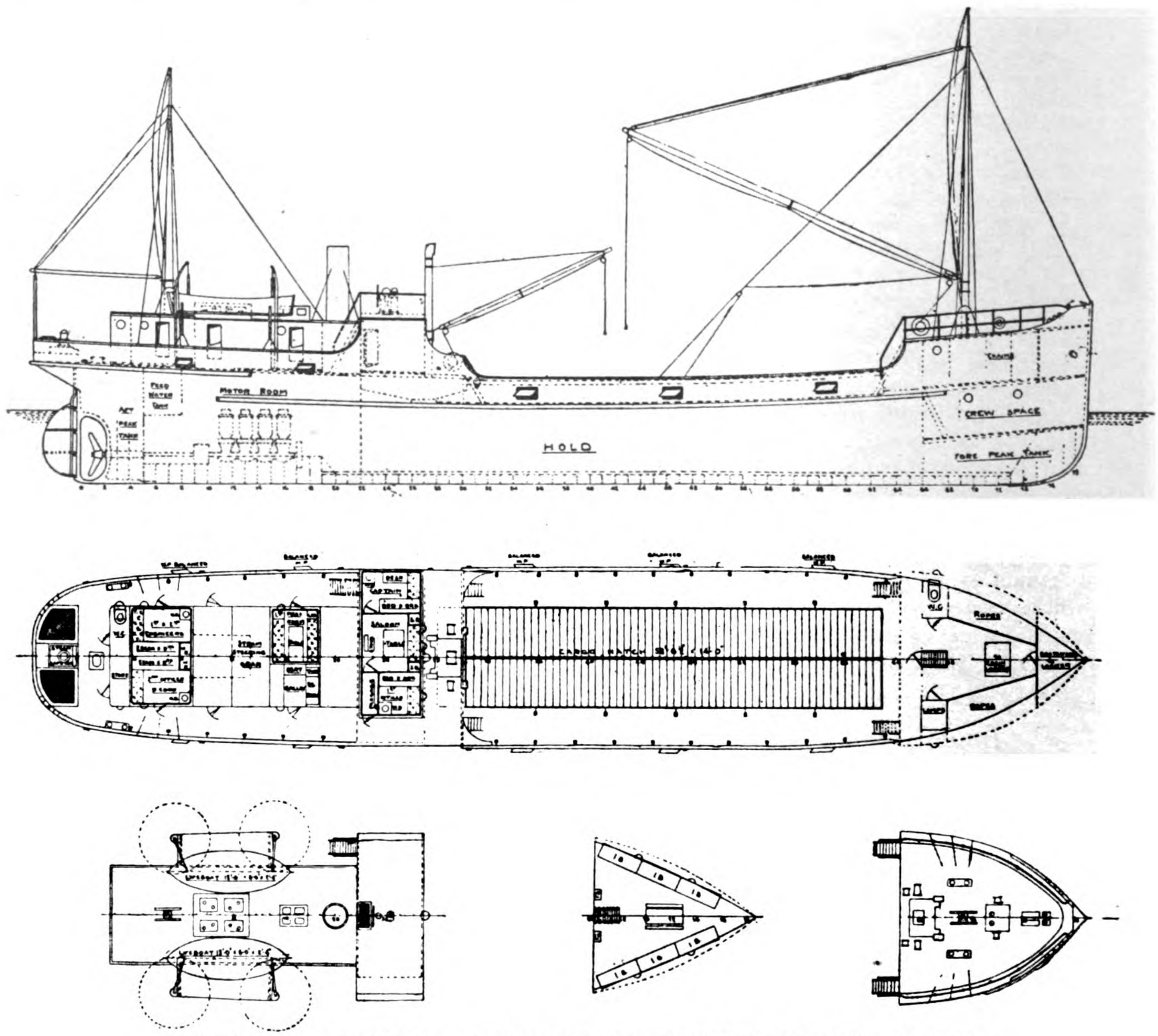
One important recommendation made by the commission is for a monument at Culebra, where the canal passes through the continental divide. It is proposed that the monument be at least 100 ft. high and of greater width, suitable for some inscription that may be read from the other side of the canal. The commission also recommends a monument at Gold Hill, the highest point in the Culebra cut, and some suitable structure in the form of an arch at the point where the channel from Limon bay ends and the canal actually begins, and something similar at the Pacific entrance. A fringe of trees rising from the waters in Gatun Lake is condemned from an architectural viewpoint. Col. Goethals said it would have been too expensive to have removed the trees. The commission recommends an additional lighthouse at the Atlantic entrance of the canal. The plan of the shops at Balboa is condemned as unsightly, but this work has advanced so far that a change in the plan is not practical. The commission approves the general plan for beautifying the Pacific entrance to the canal.

Motor Ship Isleford

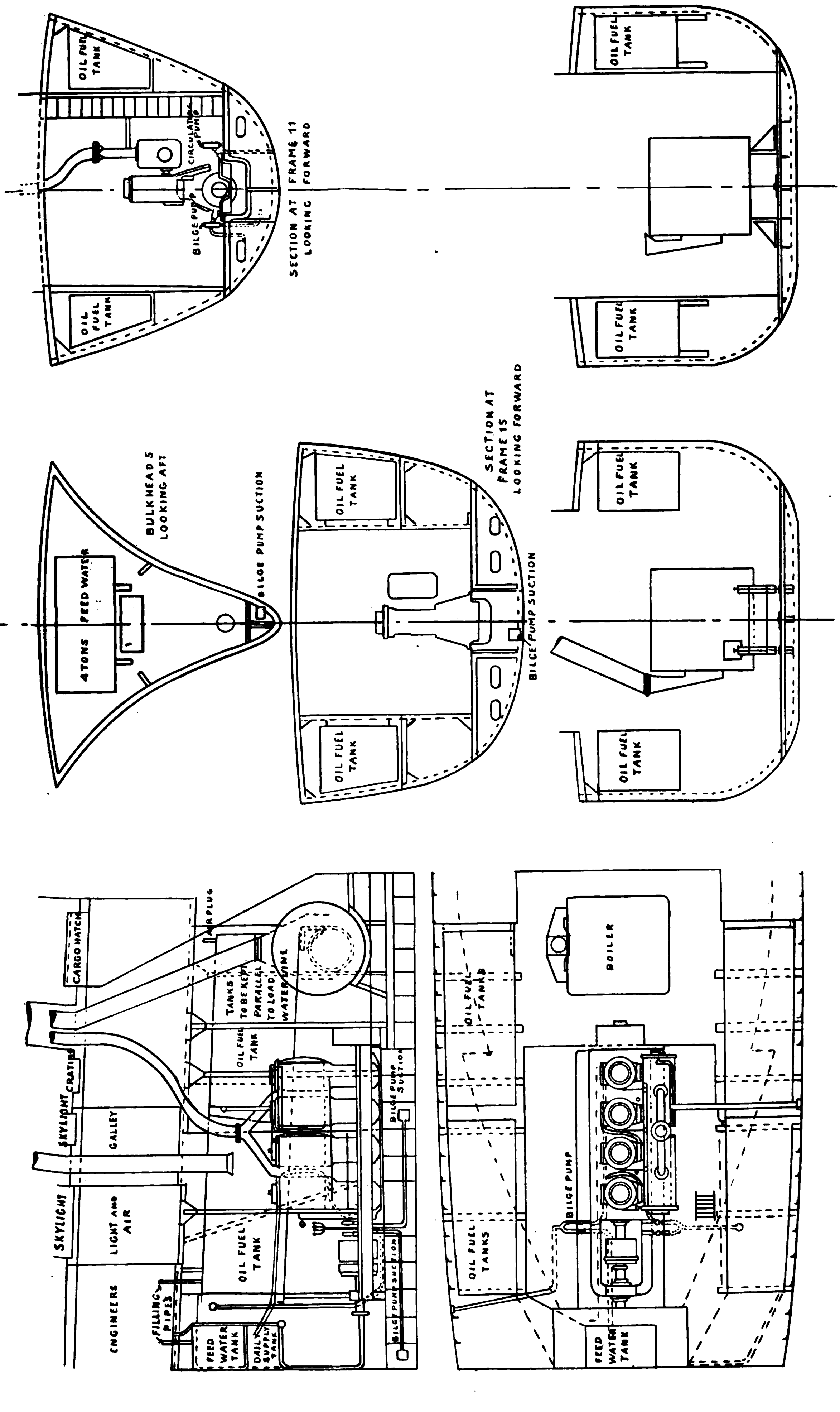
The Largest Semi-Diesel Engine Afloat — Results of Her Trial

GREAT progress has been made, especially abroad, during the past twelve months in the building of Diesel engined ships, but quite as much, and possibly more progress has been witnessed in the direction of semi-Diesel or low compression residue oil installations. In powers up to 130 B. H. P. the semi-Diesel is a success and can be depended upon to stand up to its work under the most severe conditions. Above this power, however, we have had no experience and hence there are divided opinions as to whether semi-Diesels or Diesels proper should be employed for powers above 150 B. H. P.

Accordingly a vessel of outstanding interest at the moment is the Isleford, which recently carried out some successful trials on the Skelmorlie measured mile. Isleford is not only the largest semi-Diesel engined ship built in Great Britain, but nothing near her size fitted with this class of machinery has been put afloat from any yard on the continent. She was constructed to Lloyds highest class by the Ardrossan Shipbuilding & Dry Dock Co., Ardrossan, for Messrs. Mann, Mac Neil & Co., Glasgow, and will be used in the general coasting trade. Her dimensions are 149 ft. B. P. S. by 25 ft. 6 in. beam, molded, by 11 ft. depth, molded, and has a displacement on load draught of 780 tons. The engine contract was in the hands of Messrs. Douglas, Primrose & Co., Glasgow, the Scottish agents for the Bolinder's motor. At first sight the appearance of Isleford does not strike one as anything out of the common, except perhaps for the enormous hatchway, which gives great facilities for the handling of long length cargoes, such as rails, beams, etc., also one cannot say there is anything striking about her underdeck arrangement.



INBOARD PROFILE AND DECK PLAN OF THE OIL-DRIVEN MOTOR VESSEL ISLE FORD



ENGINE ROOM ARRANGEMENT OF THE OIL-DRIVEN MOTOR VESSEL ISLEFORD

The deck arrangement consists of ample sized cabins situated aft, for chief and second engineers. The captain's cabin is situated forward at the break of the poop on the starboard side and on the port side is the mess room.

Regarding the deck machinery this is all steam driven and consists of two powerful winches at each end of the hatch, a heavy warping winch on the forecastle and a capstan aft. Steam steering gear is also fitted, the wheel being situated on the flying bridge.

The Propelling Machinery

Coming to the most interesting part of the ship, *viz.*, the engine room, one is at once struck with the clean and light appearance, a difference from the machinery space of the typical steam coaster of this size. This apartment, as will be seen from the plans, is situated right aft and is entered from the poop deck just forward of the engineer's cabins. The main machinery consists of a four-cylinder Bolinder's direct reversible motor, developing 350 B. H. P. at 225 r. p. m. and consuming residue oil of a specific gravity of 0.87. All the engine controls are arranged on the port side within easy reach of the man on watch and in close proximity to the telegraph, while coupled to the forward end of the crank shaft is a 4 in. bilge pump, working at the engine speed. As is well known the Bolinder's motor is of the now popular solid injection type. There is no cam shaft or intricate valve gearing, the fuel pumps, circulating water pump, etc., being driven from eccentrics at the aft end of the engine. Generally speaking the engines have a remarkably clean appearance and are what might be termed a sound heavy job.

Forward of the engines and placed 'thwartships is a small donkey boiler, of the single headed Scotch type, with one furnace fitted with oil fuel burning apparatus of the Wallsend-Howden patent system, the fuel used being taken from the ship's main tanks. On the port side under the fuel tanks are situated a steam bilge and ballast pump interconnected with the bilge pump on main engine, a boiler feed pump and an oil pressure pump in connection with the boiler firing system. The gases from the donkey boiler, as also the exhaust from the main engines are taken up a common funnel, on which is mounted an organ whistle and siren. The main requirements for the steam boiler are, of course, the deck machinery previously described. Twenty-five tons of fuel is carried in four galvanized tanks arranged two on either side of the engine. These are connected to a common service tank of 150 gallons capacity on the outlet pipe of which there is a large gun-metal filter with four hand pumps mounted thereon for initial charging of fuel pipes, each coupled to the pumps on the main engine. A water tank for engine service is arranged right aft, having a capacity of four tons of fresh water. This, however, is larger than necessary, as one of the features of these Bolinder's engines is the light water consumption, in fact it has been proved by the 80 B. H. P. Scottish coasters Innisbhu, Innisagra and Innisnee that with a slight reduction in power the Bolinder's motor can be run for long periods without water.

As is general with high powered heavy oil engines, starting is by compressed air and the air reservoir which is charged under normal conditions direct from the main engines is situated on the starboard side under the main fuel tanks. Should by any chance the air give out when the engines are stopped a small hand compressor fitted can be used for charging up.

Working of the Engine

Now as to the working of the engines, sufficient has already been written regarding the operation of these two-stroke cycle motors, and it will perhaps suffice to say that the starting and reversing is most reliable. Lamps are, of course, used for heating up and from cold the engines can be got under way in twenty to twenty-five minutes. The operation of the reversing gear is on the same principle as the smaller engines of this type; a remarkably neat device, however, is fitted, automatically throwing in the governing mechanism as the clutch is withdrawn, thereby preventing any racing of the engine. A short description of the oil firing apparatus on the donkey boiler may here be of interest. In this system the liquid fuel is injected into the furnace by means of a special oil-fuel pump. The oil is forced into the furnace in the shape of a conical spray of exceedingly fine particles, which burst into flame at a distance of six to eight inches from the nozzle.

For getting up steam an auxiliary apparatus is supplied which obviates the necessity of using wood, coal or other fuel, other than the oil itself, when raising steam in the boiler. This apparatus consists of a small auxiliary oil-heater, which is heated by means of a napththa burner. A small independent hand pump enables the oil to be pumped to the auxiliary heater, thence the oil passes through a duplex discharge strainer, and so to the burners. When sufficient steam is up to employ the steam oil pump, the hand pump is put out of action and the oil is drawn from the oil tanks by means of a steam pump and thence delivered to the main steam-heated oil fuel heater, where it is heated to the required temperature. After leaving the heater, the oil is filtered by passing through the duplex discharge strainer, and from there it passes to the distribution valve box and thence to the burner. A circulating pipe is fitted between the distribution valve box and the pump suction, so that the apparatus may be kept working, and the oil heated without necessarily working the burner. The air vessel being provided on the oil discharge pipe to maintain a constant pressure of oil. This fuel-burning arrangement, when correctly adjusted, is practically smokeless, and the fire tubes will not soot up; the boiler, in fact, will steam quite regularly for days together without any fluctuation in the amount of steam produced. Generally speaking, the whole engine-room arrangement presents the appearance of a well-thought-out job, and the engineers, Messrs. Douglas, Primrose & Co., are certainly to be congratulated on the equipment and working of the machinery.

Regarding the speed trials, which, by the way, were of a semi-private nature, the vessel left Ardrossan, after loading up, at mid-day on the date mentioned and proceeded to the Skelmorlie mile. The weather was clear and calm. On a series of four runs over the mile a mean speed of 9.05 knots was attained, the engines running at 223 revolutions per minute, or practically their designed speed, which was most satisfactory, considering that the guarantee was 8.5 knots. At the conclusion of the speed trials maneuvering tests were carried out, and these also proved very satisfactory, the vessel being brought from full ahead to a dead stop in 1 min. 50 secs. Altogether the ship was under power about seven hours.

At time of writing, it is the intention of the owners to have an eight hours' full speed demonstration run, at the conclusion of which the vessel will leave for the Mersey with her first cargo. The oil used during the trials was Scotch shale of a specific gravity of 0.87.

The American Boiler Manufacturers' Association will hold its twenty-fifth annual convention at the Hollenden Hotel, Cleveland, September 1st to 4th inclusive. This convention will prove of special interest to boiler and tank manufacturers and steel plate users, in consequence of the proposed adoption of the standard and uniform boiler specifications.

Electrifying Panama Canal

Construction Work Has Begun on the Transmission Line—Elaborate Plans for Electrical Energy

CONSTRUCTION work has begun upon the permanent electrical transmission line across the Isthmus. A few foundations for the track-span bridges have been placed at New Culebra siding, on the Gold Hill relocations of the Panama railroad, and first shipments of steel for the bridges have arrived from the United States. A shed is being constructed in the abandoned borrow pit just east of Gatun Locks, for the assembling of the bridges.

The transmission line is fundamentally to transmit electrical energy from a source of generation at Gatun to load centers at Miraflores, Balboa, and Cristobal. The system is simple and straightforward. At the Gatun spillway, a portion of the lake water will be passed through turbines to generate electrical energy. The energy, generated at 2,200 volts, 25 cycles, three-phase, will be carried along the east wing of Gatun dam by heavy cables in duplicate underground duct-lines, and through tunnels under the locks, into a transformer substation, situated on the east side of the locks. The duct-lines are in duplicate, to insure maximum safeguard against damage in event of a burn-out of a cable in one or the other of the lines, and are to be laid approximately 600 feet apart.

At the Gatun substation, which is to be situated at the north end of the hill upon which the present Atlantic Division office building stands, the electrical energy will be transformed from 2,200 volts to 44,000 volts by means of step-up transformers. The equipment, in addition to three 2,000-kilowatt transformers, will consist of the necessary lightning arresters, oil switches, buses, control board, and other auxiliary appurtenances. Two high-tension lines will emerge from the substation and tap into duplicate transmission lines.

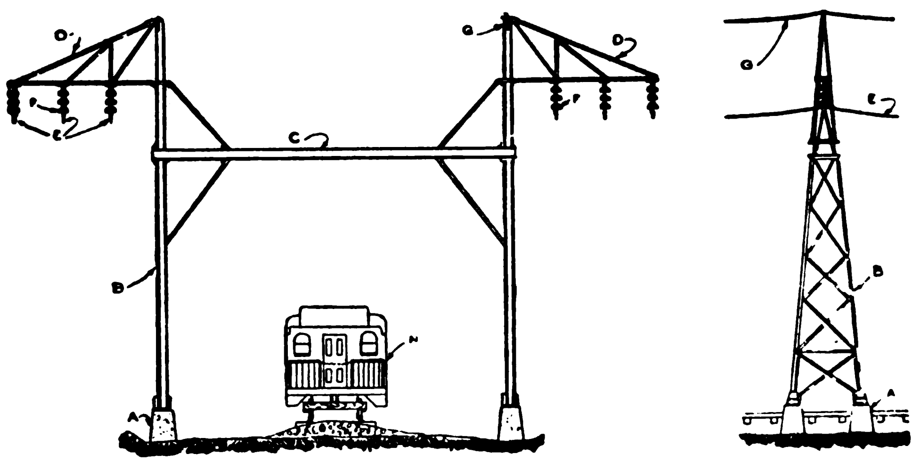
The transmission line will run from Cristobal to Balboa, completely across the Isthmus, permitting distribution of energy both ways from Gatun. The line is to parallel the right-of-way of the Panama railroad for its entire length. At Cristobal and Balboa will be terminal substations similar to the Gatun substation. The terminal substations will receive the energy at 44,000 volts, less the voltage drop in the line, and step-down transformers will convert the pressure to 2,200 volts, which will be the distributing voltage for all circuits. At Miraflores, a substation will be installed for supplying energy for the motors and lamps of Pedro Miguel and Miraflores Locks. If electricity is required along the line, the transmission lines will be tapped by outdoor type of transformer substation equipment. This will probably be done at Caimito, to supply electricity to the high power radio station; at Monte Lirio, to supply power to the bascule bridge, and at any permanent town or military reservation which demands electric lights and power.

Retaining the Miraflores Plant

At Miraflores, the present steam turbogenerators will be tied into the permanent electrical system through 2,200-volt tie-lines extending to the Miraflores substation. This steam station will serve as a reserve in the event the hydroelectric station at Gatun should break down. In emergency, energy from Miraflores will be transmitted back to Gatun and to the terminal substations at Cristobal and Balboa, insuring a continuity of service on the system at all times. The present steam station at Gatun, which has been operated during the construction period, may be abandoned in a year or two if conditions warrant placing entire dependence upon the water power. It will, however, be tied temporarily into the system, until abandonment, and will also be required to supply energy to Gatun Locks until such time as the transmission system is fully installed.

The type of transmission line which has been adopted is illustrated in the accompanying sketch. The track-span bridge supports one of the duplicate three-phase lines upon each side of the railroad tracks. Each of the three power conductors is carried from suspension insulators attached to a side bracket. The conductors are No. 00 in size, and are five feet apart and five feet from the frame. The insulators are made of vitreous porcelain, in three units, which is ample to sustain the impressed potential of 44,000 volts. The insulator fittings are made entirely of monel metal to resist climatic corrosion. A ground wire for protection against lightning is carried at the top of each side frame. The ground wire is 5/16-inch copper-clad solid wire. The copper-clad wire is being furnished with a copper sheath of nearly one-half the area of the wire, surrounding an amalgamated, carefully selected steel core.

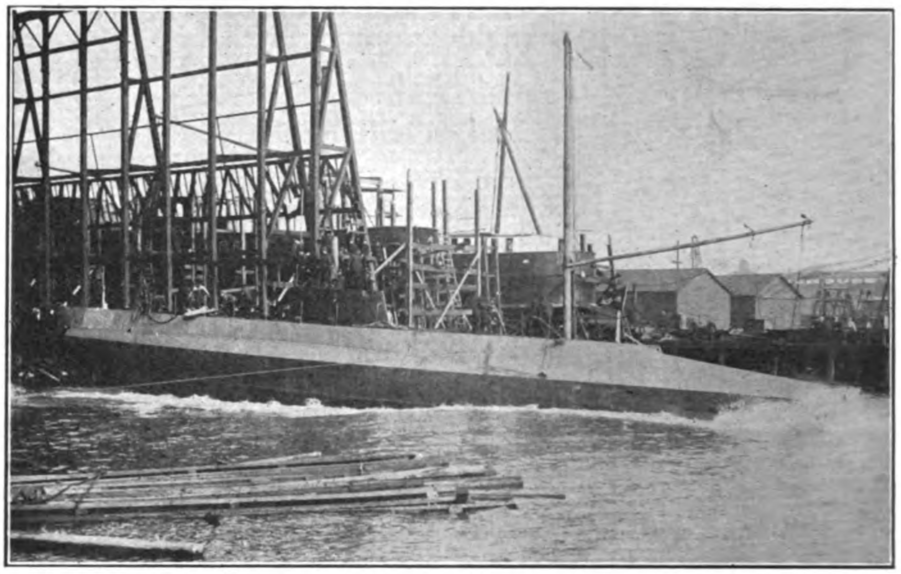
The steel bridges are spaced on 300 ft. centers, a total of 917 being required across the Isthmus. The span between side frames is 36 ft. The track-span bridge, in addition to supporting the duplicate transmission lines, admits of the suspension of a catenary trolley construction, should it prove desirable in the future to electrify the Panama railroad.



TRACK-SPAN BRIDGE, CRISTOBAL-BALBOA TRANSMISSION LINE, FRONT AND SIDE ELEVATIONS: A, CONCRETE PEDESTALS; B, SIDE FRAME; C, CROSS BRIDGE; D, BRACKETS; E, THREE-PHASE TRANSMISSION LINE; F, SUSPENSION INSULATORS; G, GROUND WIRE; H, PANAMA RAILROAD CAR

The construction adopted has several advantages for transmission purposes. By paralleling the Panama railroad, material can be brought to within a very few feet of the point of actual erection. The side bracket suspension of the conductors separates the duplicate lines so that a burn-out in one will in no manner affect the other. The conductors are outside the track and will be comparatively free from deterioration caused by smoke from the locomotives. The structure itself is fundamentally strong and is capable of easily resisting all strains introduced by breaks in the wires.

A few details of construction are worthy of note. The No. 00 copper conductors are 7-strand pure copper cables, totaling 1,500,000 ft. in length. The individual strands are manufactured without either a soldered or a welded joint. Splices in the cable will be made with soft copper sleeves. The conductors are suspended at the insulators from monel metal fittings, which are bushed with a copper sleeve. Thus, in the entire length of line, there will be no point where the copper strands are in intimate contact with a second metal; this prevents the introduction of an electric couple and consequent electrolytic deterioration.



LAUNCHING SUBMARINE H-3 AT THE YARD OF THE SEATTLE CONSTRUCTION & DRY DOCK CO., SEATTLE, WASH.

Ground Wire Clamped to Tower

At each track-span bridge, the ground wire will be clamped to the tower, and a positive T-connection through a copper wire will be made to ground plates buried in the earth. These ground plates are being manufactured from old scrap copper and cable which have accumulated at the Empire storehouse. By frequently grounding the ground wires, it is expected that line trouble and substation burn-outs caused by lightning will be reduced to a minimum. Five hundred thousand feet of copper-clad wire are required for the two ground wires.

The insulators, which will support the conductors, are of two types, suspension and strain, each assembled of three porcelain discs, ten inches in diameter, joined by monel metal fittings. This metal is used on account of its unusual strength and its ability to resist corrosion; galvanized fittings which are customarily used in the United States and abroad are considered practically worthless in the Isthmian humidity. The strain insulator is to be used on sharp curves and for anchoring at intervals, and the suspension insulator is to be used upon tangents and light curves. The suspension insulator swings freely from the bracket, while the strain insulators take the position of the conductors and hold the conductors more rigidly to a line. Each wire requires two strain insulators per bridge on sharp curves, and one suspension insulator is required for each wire per bridge on tangents and light curves. Four thousand suspension insulators and 2,500 strain insulators have been ordered for the entire line. The total weight of the copper conductors, including the ground-wires, will be approximately 400 tons.

In the design of the bridge the steel is distributed, so as most efficiently to resist the maximum stresses incurred. The side frames are A-frames, to resist uprooting of the bridge in event all wires are down in one span. The crosspiece is made of two channels, which are cross-braced to carry the longitudinal pull of the catenary construction which may be attached if the railroad is electrified. The side brackets for supporting the line conductors are three-legged, designed both to support the weight and to resist the torsional pull of the wire. The brackets and the crosspiece are braced to the side frames to that the entire bridge acts as a unit to resist side pull on sharp curves.

The type of concrete foundation for the track-span bridge has been given considerable study. The standard foundation will consist of two pedestals under the two legs of each side frame, the pedestals resting upon a spread slab which latter is reinforced by scrap steel rails. Each leg of the side frame is to be secured to the pedestal through two 15-inch anchor bolts, which are clamped at the lower end to the steel rails on the spread slab. Provision for anchoring the foundations is made by extending downward long reinforcing rods, encased by concrete in a drilled hole, which latter has been sprung at the bottom with light charges of dynamite. The foundation should afford a thorough footing, both for the normal bearing and for anchorage to resist side pull when wires are broken.

Among the permanent loads which are to be placed on the transmission system the following are tabulated:

Place.	Division.	Description.
Colon	Public wks.	Sump pumps.
Cristobal	Panama R. R.	Docks, light and power.
Cristobal	Subsistence	Bak'ry, laund., cold stor., ice plant.
Mt. Hope	Second	Coal hand'g plant.
Mt. Hope	Public wks.	Colon waterworks.
Gatun	First	Lock mchy. and lighting.
Gatun	Atlantic	Agua Clara pumping plant.
Monte Lirio	Panama R. R	Bascule bridge.
Caimito Jct.	Navy dept.	Wireless station.
Pedro Miguel.	First	Lock mchy. and lighting.
Miraflores	First	Lock mchy. and lighting.
Miraflores	Public wks.	Water pump. plant.
Balboa	Second	Dry docks, permanent shops.

In addition all permanent towns in the canal zone will be supplied with electric lights, and the range and beacon lights and the Panama railroad signals will be furnished with electrical energy when required.

New York Central tug No. 18 was launched from the yard of the I. S. Marvel Ship Building Co., Newburgh, N. Y., July 17. The tug is contructed of steel, 111 ft. long, 26 ft. beam and 13 ft. 9 in. deep. The engines, fore-and-aft compound, are to be installed by the W. & A. Fletcher Co., Hoboken, N. J.

Robert Palmer, president of the shipbuilding firm of Robert Palmer & Son, Noank, Conn., died on July 20 at the age of 89 years.

A Job on the Magnolia

By James Rossan

Upon her arrival in port the Magnolia had sent in a call for boilermakers, and Cassidy was the man selected to take charge of the job.

As it was early in the morning he arose from his bed, invigorated himself with a cold bath, attired himself in clean linen and a natty suit of clothes, donned his shiny derby and spotless gloves and proceeded to the shop.

Through a wireless call-system his assistants and helpers had been summoned and were here awaiting his arrival.

Promptly Cassidy went to a number of lockers conspicuously marked for various repair tools. Opening a door he brought forth a small truck plainly marked "Material and tools for repairing a re-enforcing ring."

"God bliss 'im for that," said Cassidy. "Shure Oi remimber the toime whin we used to have to hunt the owld shop over to find sledges, driftpins and other contraptions that we need. And just think, here we are, me hearties, ready to start in two minnits."

By the aid of skids the truck was easily backed aboard the low automobile, and they were off at a ten mile clip, while Cassidy held discourse on the days when they used to bump over the cobblestones in an old express wagon or, more often, walk through dangerous railway yards with a heavy pack on their backs at the risk of their lives.

Arrived at the steamer they were met by a pleasant engineer, complimented their promptness in responding to his summons and then taken to the job where the re-enforcing-ring around a manhole had split.

"Here you are, Mr. Cassidy," said the engineer. "You will observe that we have cleared all piping and other obstructions away. We have not only blowed down the central boiler where the job is, but also the two others for fear the heat would be oppressive. As I feared some bad air still remained I have installed a dozen portable electric fans to give a good circulation and supply a cold draft. To eliminate dirt or any possibility of you soiling your clothing we have scrubbed the boiler tops and adjacent work with the sandblast, which renders it chemically clean. You will also note that we have placed a number of comfortable chairs near your work. Please make yourselves comfortable, do not hurry, you will find it a pleasant place to work."

"Now that's what Oi'd call a gintleman," said Cassidy. "Shure Oi moind the day, more's the pity, whin we used to crawl to our work through soot and grime, and in a heat that'd boil the kidneys out of ye."

Presently, after a smoke and a pleasant chat, they started the job. A machine worked by a compressed air tank no larger than a water pail was used to shear off the rivet heads. This was a combination machine and was also used to punch out the rivets, and to ream and fair the holes for the new ring, and finally it served both to hold on and drive the new rivets. There was practically nothing for the men to do but to sit in their comfortable chairs and watch their respective gages for the pressure applied. Even the smoke and gas from the usual forge was eliminated, as the rivets were heated in an electrical furnace.

"Oh, the heartache of it all!" said Cassidy, as he neatly adjusted the pressure to a pound while setting up a hot rivet. "It makes me blood boil whin Oi think of how we used to flog and slug on 'em only to find that they were ayther not up at all, at all, or ilse up so tight that they'd burst whin cool. And here Oi am putting 'em up so neat with the pressure of me thumb that Oi havin't missed one in a year."

They took their time, adjusted their machine with precision, and were careful not to soil their clothing. At meal time they were taken to the dining room and served with good, substantial food, and hot coffee and sandwiches were served between.

But all things have an end, especially good things. The job was finished, the brightly polished tools wiped clean and placed in their respective places on the truck. Leisurely they donned their clean collars and neatly brushed hats and coats and jumped aboard the auto for a pleasant jaunt back to the shop in time for an early quitting hour.

"Good bye, gentlemen, and a pleasant evening to you," said the engineer.

"Thank you, sir," Cassidy answered, "and many happy returns o' the day." Then as he took the steering wheel and threw in the clutch, he added: "Shure, a boiler maker's job's the nifty job today."

Perhaps the auto struck something, there was a fearful jolt as Cassidy was yanked from his bed out on the floor.

"I've been trying to wake you for fifteen minutes," said the watchman from the shop. "Hurry now, man, there's a split manhole ring on the Magnolia and ye're the man to go and do the job."

Cassidy rubbed his eyes, dropped back in bed and muttered:

"Ye can go to blazes! Oi've done work enough on that owld hooker to know her. She's hot enough to fry the liver out o' ye up there, we have to lie in the soot and swing a sledge in a place where it would bother a rattlesnake to get through. There's a nigger driver of an engineer who expects ye to do two days' work in one. No, sir, none o' that fer me!"

"The boss said if ye didn't get down there as quick as ye know how ye can be looking for yer time in the morning," the watchman continued.

Slowly, sleepily, disgruntled Cassidy donned his soot begrimed overalls. As he wended his way to the shop, facing the wind and sleet, curses deep and sonorous rang out on the frosty air of the night.

Gatun Lake on Final Rise

Anticipating the schedule, the last gate of the three 8 x 18 ft, sluices through the ogee of the Gatun spillway dam was closed at 10:40 a. m., on June 27, with the surface of the lake 48.25 ft. above sea level. It is not expected to open the gates again, and the lake may be considered to be on its final rise to operating level. Under conditions of normal runoff, as determined by measurements recorded over the watershed for the past 23 years, the lake should reach 85 ft. about Dec. 1, 1913; it should rise to 71 ft., the elevation of the railroad at Gorgona, about the first of October. At that height it would afford a 21-ft. channel. The top of the dike at Gamboa, protecting Culebra cut from flooding through its north end, is 78.2 ft. above sea level, but it is anticipated that the water will be let into the cut before the lake has reached that elevation, which it may do about the first of November.

The channel between Gatun and Gamboa has been completed since July, 1912, with the exception of about 300,000 cu. yds. of gravel, washed into it by the Chagres river, which are to be removed by dredges. From Gatun to Bohio no excavation was required, except a small quantity of Pena Blanca; the surface of the ground was less than 40 ft. above sea level, and the full lake will afford depth enough for the ships. The channel needed only to be cleared of vegetation and marked with lights and buoys. From Pena Blanca to Tabernilla the excavation was mostly

in cutting off the tops of the peninsulas, found by the tortuous course of the Chagres. The heavy work was from San Pablo to Gamboa. Total excavation in the Chagres district to date has amounted to 12,384,655 cu. yds. Including what remains to be done, the total excavation for the channel through Gatun lake is less than the excavation accomplished in Culebra cut every year since 1907.

Gatun lake came into existence on April 25, 1910, when the west diversion at Gatun dam was closed, and the flow from the Chagres and Trinidad rivers was forced through the spillway channel. The head of the spillway was 10 ft. above sea level, which caused the water to rise to a normal surface of 14 ft. above the sea. In times of flood, the surface rose to about 18 ft., indundating parts of the Panama railroad through the Black swamp. On Feb. 15, 1912, the relocated line of the railroad, between Gatun and Gamboa, was placed in use and immediately afterward the removal of the old line was begun. About the same time the sluice gates were closed and the lake was allowed to rise. It attained a maximum elevation of 56.3 ft. on Nov. 30, 1912. At this height the water poured over a gap, at 50 ft. above sea level, in the uncompleted ogee, and, in order to allow the completion of the dam during the dry season, the sluice gates were opened in December. On Jan. 1. 1913, the surface of the lake was 48.3 ft. above sea level, around which it has been maintained since.

Lloyds Register of Shipping

A slight decline in the amount of gross tonnage under construction is shown in the quarterly shipbuilding returns of Lloyds Register. At the end of the first quarter on March 31, there was a greater tonnage being built by 60,000 tons than on June 30. But the completion of some ships of the largest size accounted for the decline. Nevertheless the present building tonnage exceeds the amount building at the same time last year by about 229,000 tons.

There are now building under the supervision of Lloyds Register 559 vessels of 2,097,867 tons. This is within 14,000 tons of the figures reported in March, the largest ever reached. Of the 559 vessels, 434 of 1,538,198 tons are being built in the United Kingdom and 125 vessels of 539,660 tons are building in other countries under the society's survey.

The following shows the detail:

	No.	Gross tonnage.
Building in U. K. for home account, for sale, etc.	329	1,180,742
Building in U. K. for foreign and colonial account	105	357,456
Building abroad for U. K. owners	9	14,307
Building abroad for foreign and colonial account.......	116	545,362

The countries for which the ships building, excluding warships, are intended, are as follows:

	No.	Gross tonnage.
United Kingdom............	392	1,533,970
British colonies	29	33,500
Argentina	14	13,705
Austria Hungary	8	24,980
Belgium	3	34,145
Brazil	4	1,560
Chili	1	600
China	1	560
Denmark	2	8 531
Egypt	1	2,050
France	9	3,790
Germany	3	12,300
Greece	6	20,940
Holland	11	114,820
Japan	4	20,670
Mexico	1	2,850
Norway	8	52,180
Portugal	1	220
Roumania	3	10,559
Russia	14	31,595
Spain	3	14,750
Sweden	3	11,330
Turkey	3	1,050
United States	1	4,500
Uruguay	1	240
For sale, or nationality of owners not stated	17	47 855

The vessels begun during the quarter number 166 steam, while 159 were launched. Though there were seven more laid down than launched, the gross tonnage was 45,511 less. There were 27 sailing vessels launched, as against 13 laid down. In this case the vessels launched, though more than twice as many, represented about 1,000 less tonnage. It may be noted that in the aggregate of vessels steam and sail building on June 30, the sailing vessels number only 24, as against 519 steam.

The favorite size of vessel lies between 4,000 and 6,000 tons, as in this class no fewer than 119 are building, as compared with 60 between 2,000 and 4,000 tons and 55 between 6,000 and 8,000. The relative size of the steamships building is seen in the following table:

100 and under 500 tons	119
500 and under 1,000 tons	37
1,000 and under 2,000 tons	41
2,000 and under 4,000 tons	60
4,000 and under 6,000 tons	119
6,000 and under 8,000 tons	55
8,000 and under 10 000 tons	16
10,000 and under 12,000 tons	16
12,000 and under 15,000 tons	12
15,000 and under 20,000 tons	9
20,000 and under 30,000 tons	1
30 000 and under 40,000 tons	1
40 000 tons and above	2

The following table shows the tonnage of vessels, excluding warships, under construction at various ports outside the United Kingdom, according to the latest returns, vessels of less than 100 tons not included.

Country	No.	Gross tonnage.
Austria-Hungary	15	76,647
Belgium	9	21,277
British colonies	38	29 843
China	2	343
Denmark	9	23,322
France	42	243,404
Germany	99	565,951
Greece	1	361
Holland	43	115,605
Italy	25	73,389
Japan	10	58,634
Norway	42	38,608
Russia	7	10,820
Spain	7	7,510
Sweden	8	8,180
United States of America .	72	169,423

The total number of vessels reported building outside the United Kingdom is 377 steam and 52 sail, or 429 altogether, with a total tonnage of 1,443,-317.

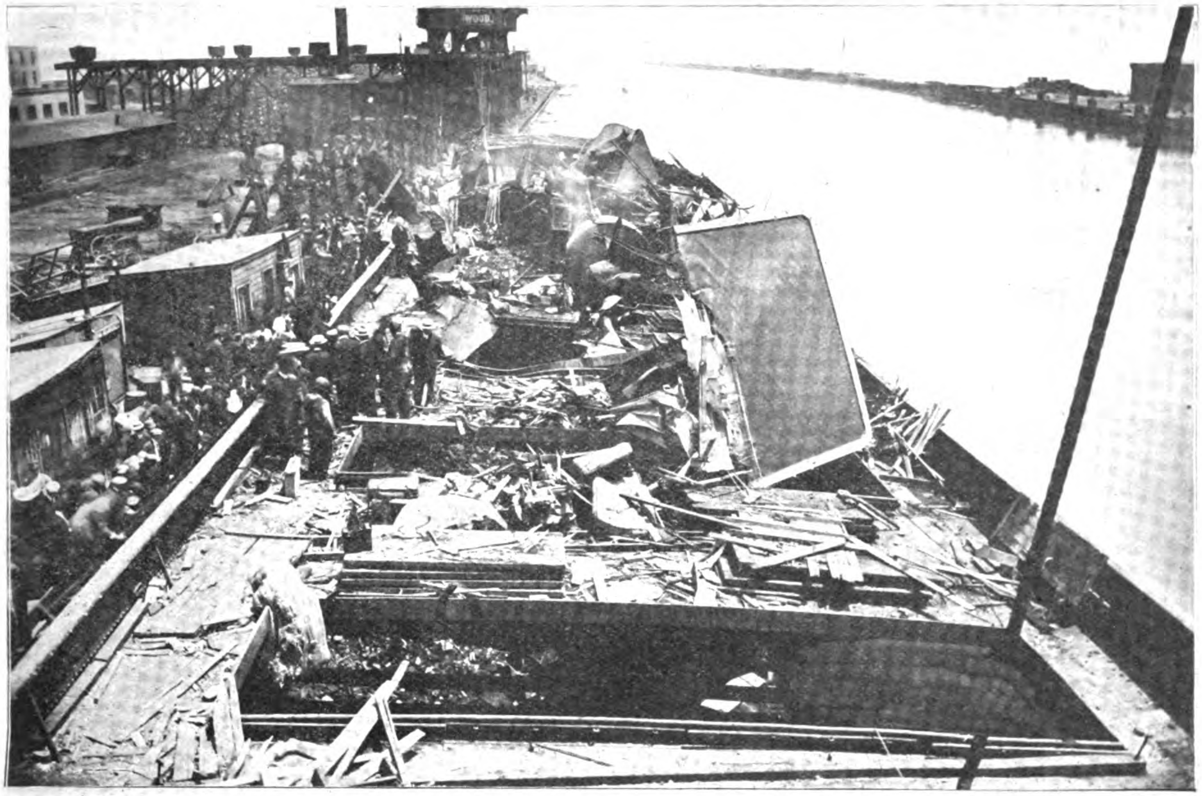
Taking the shipbuilding in the United Kingdom since 1882, a diagram shows that from 1,000,000 tonnage under construction at the beginning of that year, there was a drop to 400,000 in 1884-5. The 1,000,000 tonnage mark was not exceeded until 1897, when there was a sharp rise to 1,400,000, a point reached again after a fall in 1901. The years 1902-3-4 showed a reaction and recovery to the same total. The industry fell off to a low point of 750,000 tonnage in 1908-9, and the boom began in the middle of 1909, since which time there was an almost continual rapid rise to the climax in March this year, when the 2,050,000 tonnage mark was reached.

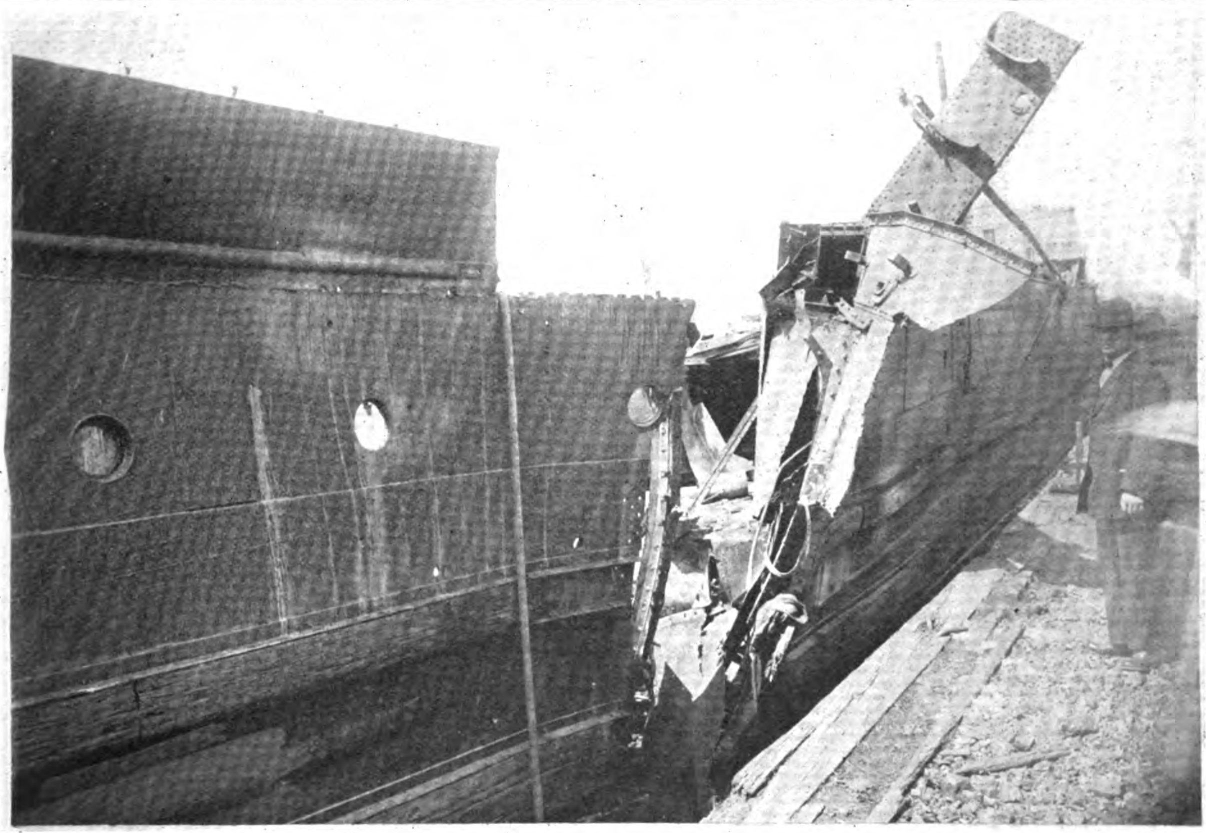
Ore Handling Charges at Dock

The special examiner for the Interstate Commerce Commission has concluded taking testimony in the controversy between the shippers and the railways for handling and storage charges on ore at the shipping ports at Escanaba, Ashland and Marquette. The railroads put into effect at the opening of the season a charge of 5 cents for docking ore at these ports and an additional charge of ¼ cent per ton per day for every day that the ore remained in storage over 10 days. The shippers objected to these charges and submitted the matter to the Interstate Commerce Commission. The railways have been given until Sept. 1 to file additional data to justify the charges, and the case will then be considered upon its merits by the Interstate Commerce Commission.

Col. G. W. Goethals, chief engineer in charge of the construction of the Panama canal, has notified Lieut. Col. David Du B. Gaillard, chief of the central division of the canal, that steam shovel work in the Culebra cut section hereafter will be conducted on the assumption that the Gamboa dike will be dynamited on Oct. 10.

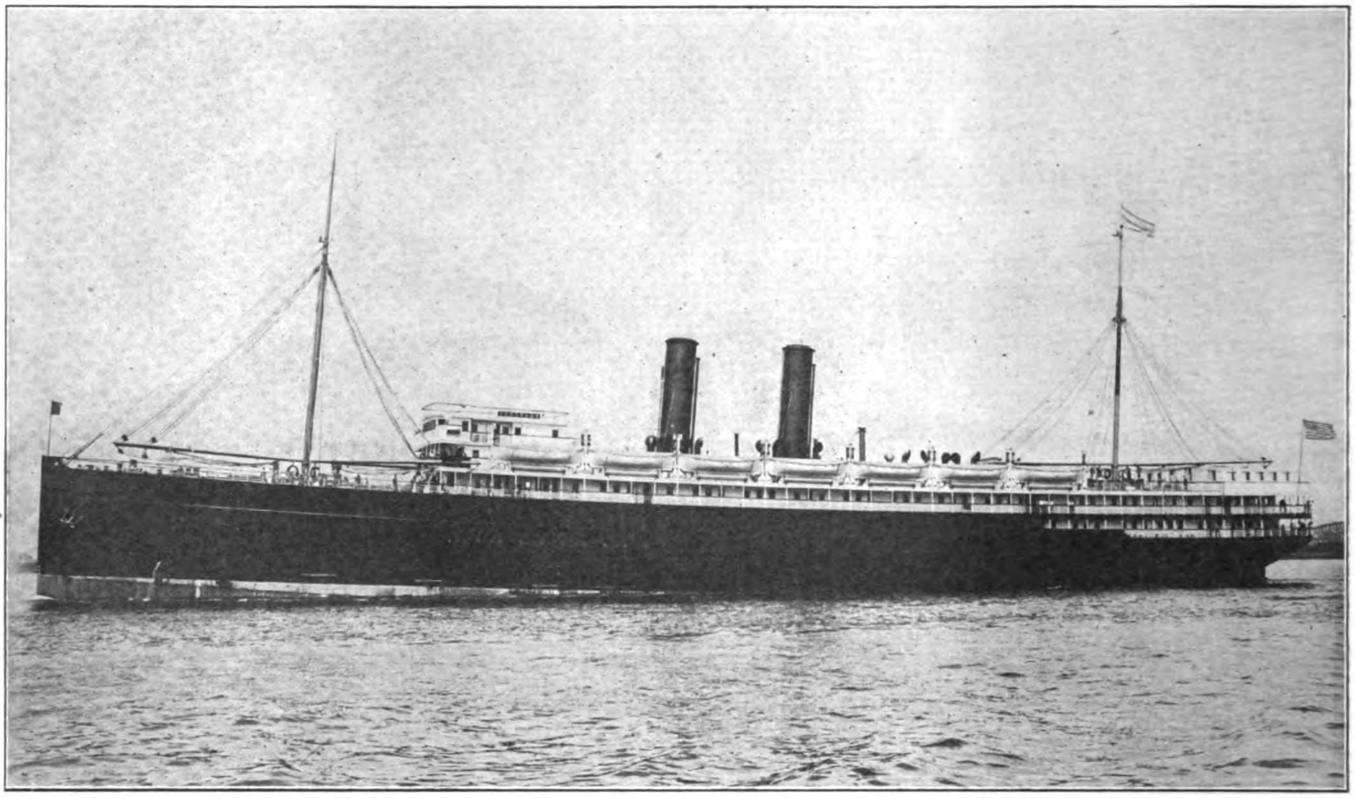
James Schoolcraft, 82 years old, a pioneer residing at Port Huron, died on July 28. His navigation career went back to the opening of the canal at Sault Ste. Marie. He retired a number of years ago.





TWO GRAPHIC PHOTOGRAPHS, SHOWING THE DESTRUCTION CAUSED BY THE EXPLOSION OF THE STARBOARD BOILER OF THE STEAMER E. M. PECK, AT RACINE, WIS., JUNE 11. SEVEN MEN WERE KILLED IN THE EXPLOSION

Photos by E. T. Billings, Racine, Wis.



STEAMER CONGRESS OF THE PACIFIC COAST CO.'S FLEET ON HER TRIAL
For description see THE MARINE REVIW, June, 1913.
Built by New York Shipbuilding Co.

Trade Notes

The Chicago Pneumatic Tool Co., Chicago, has just issued a pamphlet devoted to pneumatic drills, reamers, wood borers, flue rolling and tapping machines and grinders. Each machine is illustrated either in wash or sectional drawings and the catalogue is quite attractive.

The American Brass Co., Ansonia, Conn., has just issued a tasty little catalogue on Tobin bronze, of which it is the sole manufacturer. Among the forms in which it comes are turned and straight pump piston rods and yacht shafting, rolled plates for rudders, center boards and pump cylinder linings, condenser tube sheets, fin keels and yacht plates, bars for forgings, boilers and pump linings, and bushings.

The Bridgeport Bronze Marine Paint Co., Bridgeport, Conn., have recently put out a folder descriptive of their paints. This paint sells for $7.00 a gallon, but the company guarantees to refund the money if at the end of the season there is any seagrowth on the bottom of a boat which has received two coats of it. The paint is as smooth and hard as glass when rubbed down.

The United States Graphite Co., Saginaw, Mich., has put out a general catalog and price list No. 19 for the trade. This catalogue, being general in nature, is obviously only a convenient reference, but complete and comprehensive information concerning the company's products is found in special pamphlets, which can be had for the asking. The general catalogue contains quite an interesting article upon graphite and graphite lubrication.

The Joseph Dixon Crucible Co., Jersey City, N. J., have just got out a tasty little booklet on the subject of "Graphite for the Boiler." The company represents that the action of graphite is not chemical and that it does not dissolve the scale nor does it attack the metal as strong compounds are apt to do. The particles of graphite simply work into the minute cracks existing in the old hard scale, and gradually penetrate between the scale and the metal, making it possible to rap it off.

The Penberthy Injector Co., Detroit, Mich., have just issued Catalogue No. 26 descriptive of the Penberthy injector, of which the company makes three distinct styles, the standard stock injector, a design to cover 85 per cent of the pressures and conditions under which injectors are used; the high pressure injector, designed for use where the steam pressure exceeds 150 or 160 pounds, or the water supply is heated beyond a certain limit; the low pressure non-lifting injector, designed for use where the supply of water flows to the injector from city water pressure or overhead supply. Each of these injectors is adequately described and illustrated in the catalogue, which will be sent to any one interested upon request.

The Producers' Supply Co., Franklin, Pa., has just issued a folder descriptive of the Producers' gas engine. The folder enters into a detailed description of the frames, cylinders, piston, crosshead, connecting rod and other parts of the machinery. The purpose has been to produce an engine strong, well proportioned, all bearings adjustable and easily got at, and with as few as possible parts. The engine is equipped with Bosch high tension magneto and jump spark plug.

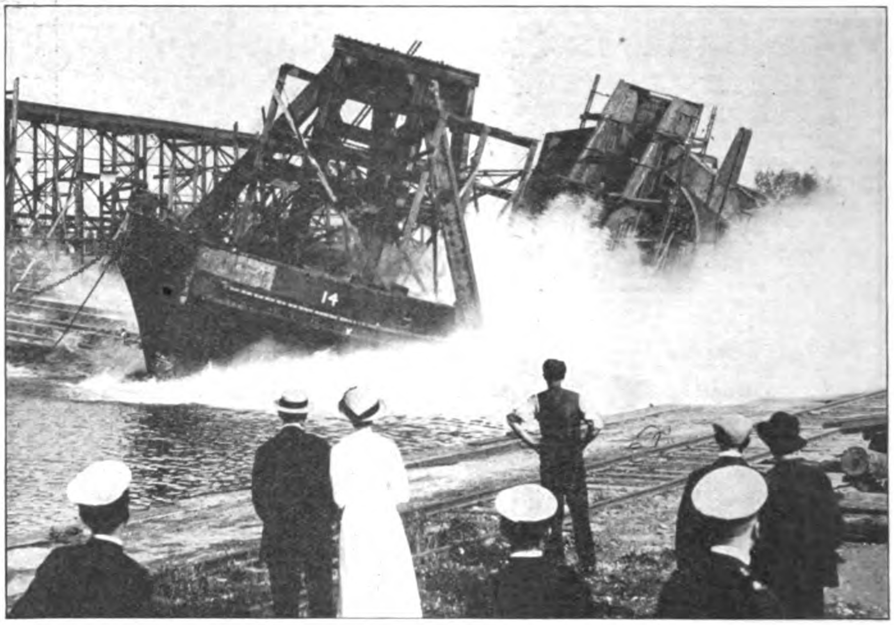
The Safety Car Heating & Lighting Co., 2 Rector St., New York, have put out a catalogue descriptive of the Safety electric light for car lighting. The catalogue completely describes the equipment of axle-driven generators. The generator is self-exciting, requiring no current from the batteries, the wiring from which is entirely disconnected from the generator when it is not in service. The commutator of the generator is complete in itself and is applied to the armature in such manner that no part of the latter,

which must be inspected, is hidden by the commutator or its connections. The development of ball bearings for generator armature shafts is a great advance in electric car lighting economy and reliability of service. The pole changer is simple, durable and accessible and provides for placing the brushes in the best position for sparkless commutation. The generator suspension on the car truck is more easily adapted to the various designs of the latter in their relation to car bodies than any other suspension. The Safety dynamo regulator absolutely guards the generator from overload and the batteries from overcharge.

E. G. T. Colles Co., Chicago, Ill., have put out a catalogue descriptive of their feed water heaters, purifiers and steam specialties. The Colles feed water heater has been on the market since 1879 and is a standard product. This heater is in general use in power plants and the catalogue describes it very thoroughly. The catalogue will be sent to any one upon request.

E. A. Williams & Sons, 105-111 Plymouth St., Jersey City, N. J., have just issued catalogue No. 26 devoted to bells and gongs. This company has been making bells since 1857 and have supplied the United States government for years. Their latest installations have been aboard the battleships Utah, Michigan, Arkansas and New Hampshire. The bell metal bell is made from a combination of Lake Superior copper and east India tin, which produces a full and clear tone. To meet a demand for a cheaper bell, the company has perfected the Williams steel alloy bell, which is cast in many sizes and sells at about one-fourth the cost of the bell metal bells. The fog signal and binnacle bells of the company have a wide sale.

Launch of Bucket Dredge



LAUNCHING A BUCKET DREDGE AT THE YARD OF THE COLLINGWOOD SHIP BUILDING CO., COLLINGWOOD, ONT.

The Collingwood Ship Building Co., Collingwood, Ont., launched the first of two large bucket dredges which they are building to the order of the Canadian government's department of marine and fisheries. These vessels are intended to operate in the St. Lawrence ship channel and are capable of digging in hard pan to a depth of 52 ft. below the water level. The principal dimensions are as follows: Length b. p., 215 ft.; breadth, molded, 37 ft. 6 in.; depth, molded, 14 ft. The whole of the work has been carried out under Lloyds special survey for their 100-A1 dredge class.

The vessel is self-propelled by means of a set of triple-expansion, surface-condensing engines with cylinders 15 in., 25 in. and 42 in. by 26-in. stroke, supplied with steam from two Scotch boilers 10 ft. 6 in. long and 11 ft. 6 in. diameter, working at 180 lb. pressure. Suitable clutch gear is arranged so that the main engine can be disconnected from the propeller shaft and made to operate the chain of buckets. All the gearing in connection with these arrangements is of a very substantial nature and designed to drive the chain of 40 buckets at speeds varying from 10 to 20 per minute, depending on the class of material which is being dredged. There are 40 buckets on the chain, each of 27 cu. ft. capacity. The maneuvering of the vessel while at work is carried out by means of exceptionally powerful winches, there being fitted one bow winch, one stern winch and two large breasting winches. In addition to these a powerful hoisting engine is fitted for operating the bucket ladder, a small winch for operating the side chute and two powerful deck capstans for warping. A very complete set of engine room auxiliaries are installed and no expense has been spared to make the vessel complete in every respect.

Accommodations for the dredging master and officers is provided on a promenade deck aft and are very airy, well-ventilated cabins, while the crew are berthed under the main deck forward on the port side. Forward of the crew's space a large workshop has been installed for taking care of the necessary repairs which may be required to the elaborate dredging gear while the vessel is in service. Vessels of this description are of a very special nature and very much out of the beaten track of the customary line of business which is followed on the great lakes.

The department of marine and fisheries was represented at the launch by Cecil Doutre, purchasing and contract agent, and the christening ceremony was gracefully performed by Miss Isabel Lindsay, the charming little daughter of Sanford H. Lindsay, secretary-treasurer of the Collingwood Ship Building Co., Ltd.

L. J. & M. Costa, 22 Prince street, Boston, are having a 114-ton schooner built at the yards of Tarr & James, Essex, Mass. This schooner, which is of knockabout type, will be equipped with a 70 horsepower Blanchard oil engine, the sail area being cut down one-third of that ordinarily used in vessels of this type. The boat was designed by Thomas McManus and is the first one of this class that the Costa firm has built.

Too Late To Classify